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THE

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OF THE

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OF CEYLON

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THE TEA RESEARCH INSTITUTE,
St. Coombs, Talawakelle,
Ceylon.

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THE TEA QUARTERLY
Conference Number
VOLUME XXVI. MARCH/JUNE, 1955. PARTS I & II.

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CONFERENCE PROCEEDINGS

OPENING ADDRESS BY H. S. HURST Esq.
CHAIRMAN, TEA RESEARCH INSTITUTE

It gives me the greatest pleasure as Chairman of the Board of Control of the Tea Research Institute of Ceylon to extend a warm welcome, both on behalf of the planting community and of the Institute, to His Excellency the Governor General, who has done us the honour of consenting to open this our eleventh biennial Conference.

When Your Excellency addressed our last Conference you displayed a very intimate knowledge of the tea industry and we are indeed fortunate that we have today as our Governor General one who is fully conscious of the fundamental importance of this industry.

We have with us here today Dr. W. Wight, the Senior Botanist of the Tocklai Experimental Station of the Indian Tea Association, who will be delivering a paper during the course of the proceedings; Mr. Peter de Jong, Chief Scientific Officer of the United Planters' Association of Southern India, whom many of you have already met at previous conferences, and Dr. T. Eden, another old friend whom we are very glad to see here again today. (Applause).

Also present are Mr. K. Morford, C.B.E., the Chairman of the Planters' Association of Ceylon, a number of visiting directors from London and representatives of Colombo Agency Houses and commercial firms; to all of whom I extend a cordial welcome.

I would also like to take this opportunity of welcoming Mr. S. Pathmanathan, the Chairman of the Low Country Products Association, Dr. H. E. Young of the Rubber Research Institute and Mr. F. C. Cooke of the Coconut Research Institute, who will be attending our sessions in Colombo.

The theme of this Conference is of the utmost importance not only to the planting industry but to the future well-being of every inhabitant of this island. I trust therefore that all of you will give your earnest attention to the proceedings which are about to follow. I will now ask you, Sir, to formally open this Conference by delivering your address, to which I am sure all present will listen with the greatest interest.

ADDRESS BY HIS EXCELLENCY SIR OLIVER GOONETILLEKE, G. C. M. G., K. C. V. O., K. B. E. GOVERNOR GENERAL OF CEYLON

There can be no greater indication of the confidence that the Tea Planting Industry has in the Tea Research Institute than this overwhelming response to the invitation to attend this eleventh Conference of the Tea Research Institute. When, as Minister of Agriculture and Food, I opened the tenth Conference two years ago, the Institute had brought to a very successful conclusion the battle against blister blight which was threatening to cripple the tea industry. Remarkable success had been achieved by team work between the scientists and planters in which all the resources available to both were utilized to conquer the disease. It was inevitable that during the battle against blister blight the attention of the working planter and the Institute should have been diverted somewhat from development in connection with manuring, bush management, manufacture and pest and disease control other than blister blight. The Conference of two years ago was, therefore, mainly a review of the existing knowledge in regard to tea cultivation and manufacture. However the two years which have elapsed since your previous Conference have been years of steady progress. The exports of tea from Ceylon last year exceeded all previous records, amounting to 361 million pounds valued at 1,123 million rupees, nearly 65 per cent. of the value of all our exports. As the result of the adoption of practices advocated by the Institute, the average yield of tea per acre is now nearly 700 pounds. You can, therefore, profitably devote your deliberations today to the future of the tea industry.

You will remember that at the time of the last Conference there was a certain amount of agitation for the re-introduction of restrictions on production by participants in the International Tea Agreement. Today the world demand for tea exceeds the supply, and the market for our produce in particular is assured. I am glad to note, therefore, that the new International Tea Agreement, which will be signed this year, will, as far as possible, avoid restrictions on extensions to existing acreages and export quotas. In its new form the Agreement will draw in as participants other tea producing countries such as the African territories, which would assist in maintaining a well integrated system of control should it ever become necessary. However, as far as Ceylon is concerned, the removal of this restriction would seem to be a purely academic issue. In the Tea Control Year 1953/54 there were only 2,835 acres of new plantation. The prices now fetched by tea are extremely high. I wonder how many of you have programmes for extending your plantations into all those uncultivated acres that exist in most estates. How many of you have plans for re-planting areas of old tea with vigorous, high-yielding, high-quality material? In the Tea Control Year 1953/54, only ten acres were re-planted. I know your answer—'new planting or re-planting is all too expensive'. But is it too expensive when you remove the incidence of costs of a new factory and of additional accommodation for labour? Is it too expensive when you consider that the yield per acre, if planted with clonal plants produced by methods of vegetative propagation, is certain to be well over 1,200 pounds per acre? All of us must listen very carefully to

Mr. Portsmouth's paper this morning. You will see in this study a challenge to the industry and to the Institute. The former arises from the fact that the cost of production of tea is based directly on the yield per acre and that the rising cost of production can only be met by increased production. The challenge to the Institute lies in their responsibility to educate the working planter and to provide planting material suitable for all areas.

In examination of the future of the tea industry we should record our thanks to the Ceylon Tea Propaganda Board for the unremitting interest it has taken in expanding the markets for tea abroad. One has heard a great deal just lately of consumer resistance in our most important market. But the liking for tea continues to grow throughout the world. The fact that one pound of tea makes at least 200 cups while one pound of coffee makes only 40 cups will always be an advantage. The United States is a coffee drinking country and competition from other beverages was so severe that when tea propaganda was first introduced into that country it was felt that much money was being wasted. However, under the pressure and intensive advertising campaigns it is now estimated that consumption of tea in restaurants in the U.S.A. has increased to about 25,000,000 pounds a year. The Tea Propaganda Board will not, I am sure, relax in its tea promotion campaign both in the West and in the Middle East. It is far wiser to assure the stability of our produce in markets throughout the world by meeting a larger demand than by restricting our present supply, or by confining our sales mainly to one market.

Our expanding production, however, should not be taken as an indication that all is well with our quality. Any complacency on this account would be fatal. The present high prices of tea, therefore, must be used to stabilize the future of the tea industry by making a very earnest attempt to improve our quality. This cannot be done by careful plucking and cultural methods alone. It must involve the use of new and better machinery in all stages of manufacture. Far too many estates in Ceylon which have high yields still use antiquated and inadequate machinery. The very careful adjustments necessary to the production of good tea cannot be maintained by these.

One must not fail also to congratulate the Ceylon tea trade for the magnificent manner in which they have built up the Colombo Auctions to its present pitch of efficiency. More and more buyers are coming to the Colombo Auctions.

May I say a word about your assistance to the tea small holders. They represent 12 per cent. of the total acreage under the crop, *i.e.* approximately 80,000 acres. At present they lag very much behind the large grower in regard to the standard of cultivation adopted on their holdings. Average yields do not perhaps exceed 200 pounds per acre. The Tea Research Institute has established an efficient Small Holdings Service which has now operated for a number of years. I am pleased to learn that the Institute has during the past year increased the cadre of this service from 15 to 20 technical officers. This is an indication of the importance which the Institute sets on the raising of the standard of cultivation in small holdings. The Small Holdings Advisory Service co-operates very actively with the Tea Small Holdings Advisory Board in the implementation of the Government's scheme of assistance to tea small holders. As a result, no fewer than 3,000 members of the 20 Tea Co-operative Societies already established are realising the benefits of the scheme. Through the service of your officers, the funds made available for this project are being put to the best use. It is a possible view that the officers of an advisory service of a Research Institute should not be encumbered with the supervision of administrative functions. We are very grateful, therefore, that the Board has agreed to permit the officers of the Small Holdings Service to co-operate in implementing the Government scheme in which our Minister of Food and Agriculture is so deeply interested. These officers by virtue of their training are most competent to undertake this type of work. It would cause a serious set-back to this scheme were they withdrawn from this work at any stage.

Gentlemen, your Director, Mr. Lamb, will not be returning to Ceylon after he goes on his final leave in May this year. Over a period of twenty years he has rendered devoted service to Ceylon's tea industry. During his five years as Director he overcame the serious threat to the industry from blister blight. Mr. R. C. Scott retired from the Chairmanship of the Board last December after serving for ten years. Nobody could have devoted himself more completely to the Institute and to the industry than did Mr. Scott during his period. I am privileged to offer, on behalf of the country, our deep gratitude to Scott and to Lamb for their services to Ceylon. Mr. Hurst, you as Chairman of the Tea Research Institute in succession to Mr. Scott, carry on your shoulders a great and important responsibility. By education and by experience you are eminently qualified to shoulder this responsibility. The future of the tea industry, as you yourself have said, is the future of Ceylon. So long as you believe in the peoples of this land you will not fail.

Chairman.—I thank you, Sir, for your most valuable opening address, in which you have so ably elucidated all the problems which face the Institute.

As its present Chairman I am most appreciative of the tribute you have paid to the retiring Director, Mr. J. Lamb, and to my predecessor in office, Mr. R. C. Scott.

Once again, Sir, I thank you very much indeed both on behalf of myself and of all those present. Thank you.

THE FUTURE OF TEA PRODUCTION

J. Lamb

In the latter part of last year, round about the time it became necessary to give serious thought to the subject of this Conference, I read a most interesting paper in the 'Journal of the Royal Society of Arts'. This paper, by R. W. Willet of the British Commonwealth Scientific Office, was on the subject of the mineral resources of the British Commonwealth and dealt in particular with some recent developments.

When I reached the first table and gave it some thought it suggested to me the theme for this Conference.

Table 1—*Mineral resources in the Commonwealth*

	Australia	Canada	Ceylon	Colonies	India	New Zealand	Pakistan	South Africa	Southern Rhodesia	United Kingdom
Fertiliser group										
Potash ...	L	A	N	N	L	N	N	N	N	A
Phosphate ...	N	N	N	A	L	N	N	A	A	N
Sulphur minerals ...	L	A	N	L	L	N	N	A	L	L
Energy group										
Coal ...	A	A	N	N	A	L	N	A	L	A
Petroleum ...	N	A	N	A	L	N	L	N	N	N
Oil shales ...	L	N	N	N	N	L	N	N	N	L
Iron ores ...	A	A	N	A	A	L	N	A	A	A
Ferro-alloy group										
Chromium ...	L	A	N	L	L	N	A	A	A	N
Cobalt ...	L	A	N	A	N	N	N	L	N	N
Manganese ...	A	N	N	A	A	N	N	A	N	N
Molybdenum ...	L	L	N	N	N	N	N	L	N	N
Niobium ...	L	L	N	A	N	N	N	L	L	N
Tungsten ...	A	L	N	L	N	L	N	A	A	N
Vanadium ...	N	N	N	N	N	N	N	L	L	N
Non-ferrous group										
Aluminium ...	A	N	N	A	A	N	N	N	N	N
Copper ...	A	A	N	A	L	N	N	A	N	N
Lead-zinc ...	A	A	N	A	N	N	N	L	N	L
Nickel ...	N	A	N	L	N	N	N	L	L	N
Tin ...	L	L	N	A	N	N	N	L	L	N
Titanium ...	A	A	N	N	A	A	N	A	L	N
Minor metals group										
Beryllium ...	L	N	N	L	A	N	N	A	A	N
Germanium ...	L	N	N	N	N	N	N	N	N	A
Lithium ...	L	L	N	A	L	N	N	L	A	N
Selenium ...	A	A	N	N	N	N	N	N	A	N
Non-metallic group										
Gypsum ...	A	A	L	A	A	N	A	A	N	A
Mica ...	L	L	N	A	A	L	N	A	L	N

A—adequate, or potentially adequate resources, or an actual or potential large surplus available for export.

L—low; a deficiency made up by import, or where there is negligible local consumption it indicates a minor export.

N—negligible; exploitable deposits are very small or at most there is no more than a token output. No reserves of any significance.

Ceylon's resources are shown in the table (Table 1) to consist only of a meagre supply of gypsum, so low in fact that it will apparently be necessary to import gypsum or some other source of sulphur if sulphate of ammonia is manufactured in Ceylon.

Having no claims to speak as an authority on economics or industrialisation I do not wish to make any sweeping generalisations about the conclusions which may be drawn from this lack of mineral resources. On the grounds of general scientific knowledge and commonsense I do, however, question the wisdom of thinking in terms of any appreciable degree of manufacturing industrialisation in this country.

It appears reasonable to assume that Ceylon must remain, as it is today, primarily an agricultural country and I do not believe that it places the economy at any real disadvantage.

What has been termed the 'Industrial Revolution', an era in the history of mankind which has been marked by unprecedented concentrations of populations with attendant slums and squalor, by bloody international strife and unrest, by ruthless exploitation of prairie and forest, is gradually losing its momentum.

Skill in the management of land is becoming as important as skill in mining and manufacturing industry. The value of agricultural products relative to industrial products is rising and I believe the rise will continue, with fluctuations, until there is a much fairer balance between the two. The industrialists cry for cheap food should be countered by agriculturists with a demand for cheap industrial products.

Cheap food and living amenities have been used to attract people to live in herds and work in industrial concentration camps. The tendency has been to lavish expenditure on urban areas and neglect rural amenities. This is grossly unfair where agriculture is the main revenue earner.

The large stable and progressive agricultural industry which we are to discuss in the next two days has been the breadwinner of this country for a very long time past and must continue as such in the foreseeable future. In the past few years much has been written and said (especially in the electorates at week-ends) about plans for the future of the country, but little has been actually achieved by comparison with the solid, undramatised progress of tea production in which I am sure we are all proud to have taken part.

I feel therefore that consideration of the future of tea production is a suitable theme for this Conference.

The past two conferences have been very severely practical. Four years ago we discussed measures for dealing effectively with the most serious threat that the producers of tea have so far experienced, probably the darkest shadow over the prosperity of Ceylon since the coffee crash. Two years ago we looked back and consolidated our ideas about the principles of management of the tea bush.

This time I suggest we should look ahead to possible improvements, especially to those inherent in replanting and in the use of selected planting materials. In so doing I feel that we should not be concerned entirely with severely practical aspects but take a broad, long view, seeking stimulation rather than instruction.

The papers to be read by the staff will not on this occasion be dissertations upon how to do this, that or the other thing in the cheapest and most efficient way. In many cases we probably will not be able to answer questions on cost or give concrete suggestions about how specific objectives may be achieved. Nevertheless I believe we shall be able to give many good agricultural reasons why consideration should

be given to replanting with selected materials. You will note that I have said agricultural reasons. As an agriculturist I feel confident that exports of tea could be greatly increased. The present demand for tea should encourage expansion and I believe that exports could be doubled by replanting only half the existing acreage of tea in Ceylon. Nothing, however, but the blindest academic detatchment could close my eyes to the fact that to replant 250,000 acres of tea will cost a minimum of 800 million rupees.

At this Conference we can only talk about the theory of replanting and advance the claims of an established, durable system of land management, which has maintained and even improved fertility of the land over the best part of a century, against other systems of land management and against other projects requiring land, labour and capital.

As I am shortly leaving the pleasing prospects of this island after twenty one years in the tea industry, and since I have been trained in tropical agriculture and have had the opportunity of seeing agricultural practices in a considerable number of tropical countries, perhaps I may be permitted to express an opinion on a subject which I believe to be of the greatest importance.

I feel that the people of Ceylon have not, and do not fully appreciate the contribution which the plantation system of agriculture, especially the tea industry, has made to the development of this island. By average standards in the tropical zone of the earth, Ceylon has made steady progress and has much to be proud of. The tea industry has provided a most substantial share of the funds which have made this progress possible. The tea industry is certainly something to be proud of, for the fact that yields are still increasing after so many years of monoculture under tropical conditions is a very real achievement. Even to the most casual traveller who has experience of the tropics, a journey through the neat, trim, green and fertile looking tea plantation areas cannot fail to make an impression.

The tea industry is the breadwinner of this country and does not deserve treatment either as a whipping boy or a milch cow. It should not be alternately cajoled and threatened but given continuous encouragement and, above all, confidence. The tea market is expanding and there is a world shortage of tea; tea production must be expanded while the opportunity is there.

At this Conference we are to discuss the golden opportunities which are before us, but I am sorely afraid that our visions will not be fulfilled unless much new capital is put into the industry. At the present moment foreign capital is tending to leave the industry rather than to come in to it.

Capital, however, is not my subject; I have very little personal experience of it. I will, therefore, in conclusion represent my views as an agriculturist to the rightist, the leftist, the 'uppist' and the 'downist', that the plantation, alias corporation, alias co-operative, alias collective farming system of agriculture is the one with the strongest claims. Ceylon does not have to emulate the kingdom of Lilliput described in Swift's political satire. There is no need at all for 'big endians' and 'little endians'. The plantation system has served Ceylon well and both the worker and the country derive far more benefit from it than they do from any other system. It is proved by long practice—give it the encouragement and confidence it requires to continue and to expand the good work it has done in the past.

THE EXPANSION OF CEYLON TEA PRODUCTION
THE PROSPECTS FOR REPLANTING AND NEW PLANTING

G. B. Portsmouth

Mr. Lamb has just drawn your attention to the fact that, owing to her lack of primary mineral resources, Ceylon must look to the expansion of her existing agricultural industries to support and improve the standard of living of her rapidly growing population. Manufactured tea now accounts for considerably more than 50 per cent. of the value of all exports, a fact which clearly indicates the predominant position held by our industry in the economic life of this country. Predominance in any field carries with it equivalent responsibilities, with the consequence that Ceylon may be expected to place most of her hopes of future prosperity on your shoulders gentlemen. Let us hope your backs are broad enough!

How is this responsibility to be discharged? To this question there would appear to be only one answer—by growing more and still better tea. Given our objective, how are we to set about its achievement? Here there would appear to be several alternatives open to us:—

First to raise the levels of yields given by our existing tea areas. This is largely a matter of correct bush management and manuring, coupled with proper attention to the control of pests and diseases. Much advice has been given by the Institute in this connection and I do not therefore propose to discuss future developments in this direction today. However, I think we may justly claim that the continual increases in crops secured over the past few years are practical proof of the general soundness of our advice.

Secondly by the replanting of wornout and uneconomic tea areas. In an article in the May, 1954 issue of '*World Crops*' I pointed out that there was every reason to accept the principle that there was an economic limit to the life of the tea bush. This is largely a consequence of the cumulative effects of damage resulting from pruning and forking operations and of pest and disease attack. This gradual deterioration is naturally accelerated under low-country conditions, with the result that the useful economic life of the bush is much shorter at low elevations. Mr. Walter will be enlarging on this point later on. Anyway once the principle of there being an economic limit to the life of the bush is acknowledged, then the necessity for all estates to accept the idea of periodic replanting or else to maintain a full re-supplying programme becomes self evident.

Unfortunately not all estates have been able to maintain a satisfactory re-supplying programme in the past. This failure has undoubtedly led to a serious decline in yields and has probably brought many of the poorest fields below the minimum economic yield level. That this lamentable state of affairs does actually exist can, of course, only be fully confirmed by determining the working costs and returns given by each individual field. However, I am not aware that any estates

keep their accounts in this elaborate manner and certainly none of you would bless me if I suggested that they should. Still I think you will all agree that as yields go up the cost of production falls. Assuming the converse to be equally true, this means that, for an estate with fields yielding from say 400 pounds per acre to 1,200 pounds per acre, the cost per pound of the tea produced from the 400 pounds per acre fields will be much higher than the cost per pound of that produced from the 1,200 pounds per acre fields. This being so, it is not unreasonable to suggest that, on the basis of the average sale prices realised for their made teas over, say, the past five years, many of the lowest yielding estate fields have been being worked at a loss.

Such uneconomic fields obviously require replanting with better and higher yielding material, or else they should be thrown out of production and turned over to growing green manures, firewood or any other crop which will give an economic return.

Possibly, with the higher prices for made tea now being realised, some of these previously uneconomic fields are now actually making a profit and you may be tempted to defer any consideration of the necessity for replanting. Such complacency is dangerous, since we have no guarantee that present high prices will continue. Furthermore the return for each rupee spent in working such poor fields must be much less than is obtained from money expended in maintaining your present high yielding fields in good agricultural condition.

Finally we come to *the expansion of the existing tea areas by new planting.* There is almost no suitable land still available for planting in tea up-country, so that it is inevitable that most of the future expansion of our industry will perforce have to take place at lower elevations. Much of this is likely to be in the low-country proper, where there are still large undeveloped tracts of crown land available, and where there is much wornout and uneconomic rubber, which is in urgent need of replanting. I trust I shall not be hurting the feelings of our friends at the Rubber Research Institute by telling you that, judging from the enquiries we are now receiving, many low-country estates are considering the replanting of such areas in tea to be a more attractive proposition than is replanting in rubber.

In what follows, however, I propose merely to discuss more general matters in connection with replanting and new planting, since Mr. Walter will be dealing with the various problems peculiar to the low-country later on.

Now, as you are doubtless aware, replanting or opening new land in tea is today an expensive operation. I do not think that I shall be far wrong if I suggest, that to do the job properly—and I must stress that it is not worth doing it if it is not done properly—may well involve capital expenditure of up to Rs. 5,000/- to Rs. 6,000/- per acre on difficult land. Well, gentlemen, expenditure of this order is a serious matter requiring careful consideration. Obviously before such expenditure can be justified there must be prospects of securing reasonable returns on the capital invested. To ensure this it would appear that yields from the newly planted areas considerably in excess of the present all Ceylon average of between 600 and 700 pounds per acre are essential. To be on the safe side yields of nearly twice this figure, or say, 1,200 pounds per acre or over may well have to be aimed at.

Can this target be attained? On the assumption that correct agricultural methods are employed and that the climatic and soil conditions are suitable for growing tea, I think that the answer lies mainly in the use of intrinsically high yielding, high quality planting material.

At the present time two entirely different types of planting material are available to us. These are plants produced from seed in the ordinary natural way, and clonal plants produced from single node cuttings by the methods of vegetative propagation.

Now I am fully aware that, given the choice, most of you would prefer to plant up with seed rather than to be put to the additional trouble of producing the necessary supplies of rooted V.P. cuttings in your nurseries. But, if we use the seed currently available in this country, can we be reasonably satisfied that the plants produced from it will give us the high yields and good manufacturing quality that we require to make our replanting or new planting an economic success? I am afraid that the answer must be a categorical NO.

The reason for this lies in the very hybrid nature of our tea. Many years ago Dr. C. P. Cohen Stuart, who was then working on selection in Java, wrote—'Ceylon tea is an awful medley of tea hybrids and Ceylon as a seed producing country stands in very bad repute among Java planters'.

Well gentlemen, no scientific breeding work has ever been carried out on Ceylon tea, so that I cannot believe that any improvement in our seed supplies can possibly have occurred since Dr. Cohen Stuart's damning comments were first made.

Anyway, from your own observations, you will be well aware of the vast range of different types of bushes which can be seen in most of our fields. However, you may not be equally well aware that the difference in type between bush and bush is paralleled by as marked a difference in yield. For example on a uniform area, comprising 1,000 bushes, of St. Coombs tea, Tubbs, recording individual bush yields, found a ten-fold range of variation in yield between bushes. Thus a large proportion of the bushes produced from seed turn out to be merely passengers.

What are the prospects of effecting any improvement in the present standard of Ceylon seed? Well gentlemen, I have been in correspondence with Dr. Wight, who is in charge of the selection and breeding work at Tocklai, and who will be addressing you later on this subject, and his opinion is that he cannot see anything practical coming from a breeding programme in less than 20 years. Results expected in 20 years time are, however, of no use to us here today and we are thus forced to look to vegetative propagation to provide us with the high yielding, high quality planting material we need.

In relying on selected vegetatively propagated material to meet our future planting requirements we are in fact only following modern scientific horticultural practice. In this connection I would like to read to you again the words of my old East Malling colleague, R. J. Garner, now one of the foremost authorities on the propagation of horticultural crops, which I quoted in my article dealing with the difficulties of clonal seed production in the last *Tea Quarterly*.

He writes:—

> 'In an orderly world the unpredictable variability of seedling plants will not much longer be tolerated. The use of clonal scion varieties is recognised as essential and recent work with fruit tree rootstocks and 'strains' of small fruits and other subjects grown on their own roots has made clear the advantages to be gained by the use of selected varieties propagated vegetatively. In years to come it seems likely that we shall insist on having all our woody and many of our herbaceous plants vegetatively propagated including perhaps forest trees and hedge plants'.

Anyway, its now time that I started to give you some idea of what the T.R.I. has already achieved in the way of providing you with the essential high yielding, high quality, selected V.P. clonal planting material.

At our last Conference I gave you details of the test yields of some of our St. Coombs 1947 series clones during their second year of plucking. I am now able to show you the full yields of these same clones for their first three year cycle in bearing. (Table 1).

Table 1—1947 *series St. Coombs Clones—1st Cycle.*

Clone No.	CALCULATED YIELDS, LBS/ACRE				Manufacturing quality	Rooting	Resistance to blister blight
	1st Yr.	2nd Yr.	3rd Yr.	Yearly Avg.			
2024	1240	2295	2655	2063	Above average	V. good	Very high
2025	745	1830	2310	1628	Average	Good	High
2023	645	1685	2030	1453	Above average	V. good	Average
2021	810	1500	1800	1370	Above average	Good	High
2022	860	1650	1535	1348	Above average	Good	Very high

You will note that all these clones have given an average yield for their first cycle well above the target figure of 1,200 lbs. per acre I suggested earlier we should aim at. Furthermore their other characteristics such as manufacturing quality, rooting ability and resistance to blister blight are fully up to the standards we are likely to require.

That these high yield levels can not only be maintained but still further increased is shown by the yield figures given by these clones for the first year of their second cycle. (Table 2).

Table 2—1947 *series St. Coombs Clones—Yields 2nd Cycle—1st year.*

Clone No.	Calculated yields, lbs/acre
2024	3995
2025	3200
2023	2475
2021	2045
2022	2310

Some of these yields, such as those given by clones 2024 and 2025, are so astonishingly high as to require no further comment on my part!

Up till now all the figures given you for the yields of our clonal material have been derived solely from test line pluckings and must therefore be treated with a certain amount of reserve. However, a few years ago approval was given to a policy of pulling out year by year a proportion of the older tea on St. Coombs and replanting with clonal material. Now we have a total of some 13 acres replanted with 13 different clones. Part of this area, planted in May, 1952, has been in bearing since July, 1954 and I am therefore able to give you for the first time today comparative field scale yields, obtained under normal estate conditions, for some representative T.R.I. clones. (Table 3).

Table 3—*St. Coombs Clonal Yields—lbs./acre for 1st six months bearing.*

Clone No.	Estate scale plantings	Clonal test lines
18	79	173
23	257	355
25	364	372
216	233	140
740	204	149
777	275	206
1114	332	149
1526	485	132
2024	518	446

These yields are for the first six months of plucking only and, for comparison purposes, I have included in the right hand column of the table the yields obtained from our test line pluckings over the equivalent period. You will note that, with the exception of the first three clones in the table, all the others have given higher yields under ordinary field conditions than when they were test plucked. This is most encouraging, since it indicates that, for the early stages of bearing at any rate, our test figures may well be on the conservative side.

Apart from these specific St. Coombs selections, other clones now under test, including many selections from outside estates, appear to be very promising as can be judged from the data for the better clones in our 1948 blister resistant test area. (Table 4).

Table 4—*St. Coombs* 1948 *Blister Resistant Test Area.*

Clone No.	CALCULATED YIELDS, LBS/ACRE				Rooting	Resistance to blister blight
	1st Yr.	2nd Yr.	3rd Yr.	Yearly Avg.		
S106	1435	2705	3665	2601	Good	Low
KEN 16/3	1700	1800	2490	1997	Average	Average
TK48	1040	1735	2410	1728	Good	Average
KEW 4/A4	940	1815	2390	1715	Good	Very high
D	1050	1535	2230	1605	Good	Very high
KEN 15/2	825	1550	2330	1568	Good	Average
OK4	940	1320	2225	1495	Good	Very high
1526	875	1220	2045	1380	Average	Very high

The highest yielding clone of this series, No. S106, is particularly interesting since it is a low-country selection from Sirikandura Estate. It has actually been planted up on a field scale on Sirikandura and Mr. Walter will be giving you more details of its performance in his talk. You will note that S 106 is the only one of these clones showing below average resistance to blister blight, but fortunately this is of rather less importance under low-country conditions. Otherwise all these clones show generally satisfactory characteristics.

Most of the objections to the wider use of V.P. material appear to be based on the theory that the plants are more difficult both to handle and establish than seedlings. In fact we have frequently had complaints from districts like Uva that it is quite impossible to use V.P. material as the plants cannot survive the drought. This prejudice is, I feel, quite unjustified and is mainly based on the fact that no attempts have been made so far to select for drought resistance. This is a matter which will naturally receive our attention as soon as the projected clonal proving station at Passara is in operation. However, the fact that suitable clonal material can be established without difficulty under Uva conditions is clearly shown by the following information kindly supplied to me by the Superintendent of Gonakelle Group, Mr. Deaker. A new clearing, on old patna land, was planted on the contour at a spacing of $4' \times 2'$ in November, 1952, and brought into bearing in April, 1954. A total of 15 different clones, including T.R.I. Clones Nos. 777, 1114, 1294, 1526 and 2024, were distributed in 46 blocks. Casualties were extremely few and the drought resisting characteristics of the clones planted can be judged from the fact that, out of a total stand of 23,020 plants, only 306 supplies were needed in 1954. Incidentally, referring to clone 2024, Mr. Deaker states that it is outstanding and that its growth and vigour has to be seen to be believed.

There may, however, be marginal areas where, owing to the fact that they carry considerable reserves of food in their cotyledons, seedlings may be easier to establish than properly selected clonal material. In such areas I think it is matter for serious consideration as to whether the climatic conditions are really suitable for planting tea at all. To grow at its best tea requires a minimum of 70 to 80 inches of reasonably well distributed rainfall per annum, and where such conditions do not usually prevail persistent high yields cannot be expected. The suitability or

otherwise of the climatic conditions in the area should, therefore, be fully considered before expending large sums on planting operations.

Apart from our avowed policy of trying to develop proved clonal material suitable for planting under the different conditions prevailing in the up-country, in the low-country and in Uva, we are also trying to simplify and standardize nursery technique. If this can be achieved, then the layout and management of the large nurseries covering several acres which will be required when planting operations are undertaken will be rendered much easier for all concerned.

At the present moment experiments are being carried out with a view to developing a simple standardised type of bed shading. This is particularly important, since, in many areas in which large scale planting operations may be expected to be undertaken, it may well prove impossible to obtain adequate supplies of the naturally occurring bracken fern (*Gleichena linearis*) now commonly used as nursery shade. One of the most promising alternatives to fern shading would appear to be the use of a light iron framework covered with an open mesh coir fabric. The frames are made as standard half-hoop sections, which are connected together along the length of the bed by a series of light round iron rods, 6 feet long, fitting loosely into slots welded on to the tops of the hoops. The whole framework is thus light and easily moveable, while it can be extended to fit any length of nursery bed by the addition of extra half-hoops and connecting rods. It is of course practically indestructible and capable of being used over and over again. The woven coir fabric is a local product, costing approximately Rs. 2/- per square yard, which can be obtained in a number of different sized meshes. It is thus a relatively simple matter to obtain the correct light intensity to give the best results in any particular locality. Incidentally experience to date tends to indicate that a rather closer weave is required under low-country conditions than is required up-country. Hardening off of the cuttings can of course be accomplished by replacing the initial fairly close weave by a much more open one. Given reasonable care this material should also last for a number of years.

Watering of a large nursery is also a considerable problem and, if carried out by hand, is not only unreliable but wasteful of labour. Accordingly experiments with various types of modern overhead irrigation equipment have been carried out on St. Coombs. Of the systems so far tried out, the B.O.I.L. oscillating line system, manufactured by Messrs. British Overhead Irrigation, Limited, would appear to be easily the most suitable for large scale nursery watering. The equipment comprises a 1½ inches diameter watering line made up from a series of 16 feet 6 inches long light alloy pipes fitted with evenly spaced nozzles, and joined by means of quick release couplings. The line rests loosely on a number of supports and is turned slowly from side to side by means of the oscillator unit, which is worked by the normal water pressure. A rectangular area of 25 to 30 feet deep on either side of the line, and up to 100 yards or so in length, can be uniformly watered in one operation. 100 yards of line will cover about 1/3 acre and the whole installation can be moved into a new position in a few minutes. Depending on the water pressure available, the equivalent of up to one sixth of an inch of rain can be put down in one hour. One unit, which complete with engine driven pump costs about £300 without import duty, should thus be capable of watering several acres of nursery.

Let me conclude by summing up the advantages which the use of properly selected vegetatively propagated clonal material for all new planting purposes would appear to offer over the unselected Ceylon seed currently available. These are:—

(1) Much higher potential yields.
(2) Better quality in the made teas.
(3) More rapid growth and hence a reduction in the time required to bring an area into bearing.
(4) Resistance to diseases such as blister blight and tolerance to pests such as the meadow eelworm.
(5) Complete uniformity among all the plants of any one clone.

THE CONDITION OF CEYLON TEA SOILS

J. Lamb

Quite obviously, if the tea industry is to give serious consideration to replanting, it is essential to know something of the general level of fertility of the soils which are to be replanted. During the past year we have been carrying out a soil survey designed to gain information about the general level of fertility of soils which have been under continuous tea cultivation using, where possible, undisturbed jungle and patna soils as indication of the original natural state.

It is by no means uncommon to hear sweeping statements to the effect that all the top soil in tea areas has been washed away, references to played out or exhausted soils and to the need for building up humus levels. Expressions of fear that high crop levels will rapidly exhaust our soils are also to be heard from time to time.

Few popular ideas about tea ever seem to stand up to examination, but in any case replanting is too expensive a project to be entered into without some information about the way in which Ceylon tea soils have stood up to continuous cultivation and cropping.

At the outset it is essential to stress the fact that there is no infallible means of testing or analysing soil which will give a simple index of its fertility or, more especially, its capacity for sustained fertility under good management. Working with a single perennial crop under a comparatively narrow range of climatic and geologial conditions does, however, simplify the problem to some extent.

The fact of the matter is that soil is a most complex mixture, or system, of minerals, organic matter, and micro-organisms, the study of which is still in its infancy. However, nothing is achieved by the contemplation of difficulties and problems can only be solved by systematic investigation.

We decided first to carry out a broad survey of simpler characteristics, which task was allotted to the Agricultural Chemistry Department. At the same time we commenced a detailed study of the biochemistry of St. Coombs soil starting with the nitrogen cycle. This task was obviously given to the Biochemistry Department.

In my talk I intend to explain some of the findings of the broad survey and later in the day I will give you some more detailed explanation of the chemical and biochemical processes with which we are at present concerned.

It will not surprise you to learn that one of the simple characters examined in the survey was the total content of organic matter. In Ceylon tea soils the type of clay is such that organic matter is probably more important than it is in other soils with different types of clay. We actually measured the total carbon content and for our present purpose we can say that the carbon content multiplied by two gives a close approximation of the content of organic matter.

Another simple character which we could measure easily was the total nitrogen content. Nitrogen content alone gives perhaps less useful information than the total carbon content alone. The ratio of carbon to nitrogen is, however, expected to conform to a certain pattern.

If, in addition to nitrogen, the nitrogen present as ammonia and the nitrogen present as nitrate are both measured, some assessment of the biological activity is possible. Moisture content, and acidity or pH measurements, completed the examination of each individual sample.

For the purpose of this survey we preferred to dig pits down to 6 feet depth where possible, and to sample the soil from the sides of the pit in six inch slices down to two feet depth, and in larger slices at the lower levels. The slices were thoroughly mixed so that the analyses indicated the contents of layers of soil of definite thickness. Deep pits give a better idea of the general nature of the soil than shallow samples and abrupt changes from surface to sub-soil are more easily seen. The general picture presented by the sides of such a pit is generally referred to as a soil profile.

The results of the survey were, on the whole, remarkably consistent, and I will shew you the figures for some typical profiles.

Naturally, we started work at St. Coombs. (Tables 1 to 5).

Table 1—*St. Coombs field No. 1. in course of replanting. Progress of plants in area so far replanted satisfactory. Pits dug in area not uprooted*

Depth	moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	20.33	4.0	2.72	0.27	8	6
6-12″	23.57	4.1	2.67	0.27	8	6
12-18″	25.35	4.2	2.11	0.23	8	14
18-24″	25.00	4.4	1.59	0.18	7	5
24-36″	26.06	4.3	1.28	0.14	7	4
36-60″	27.41	4.3	1.04	0.11	8	3
60-84″	29.28	4.9	0.88	0.09	7	5

Average 1.75

Table 2—*St. Coombs jungle. Relatively undisturbed jungle in same field.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	25.84	4.2	4.81	0.46	8	12
6-12″	23.37	4.3	2.45	0.28	3	6
12-18″	21.74	4.3	1.68	0.20	7	4
18-24″	19.17	4.3	1.55	0.16	8	3
24-36″	20.05	4.4	1.33	0.13	7	2
36-60″	20.59	4.7	0.81	0.08	5	2
60-84″	14.93	5.1	0.40	0.02	3	2
	16.50	4.6	0.34	0.02	2	2

Average 1.91

The pH figures shown are low because they are measured in a special way. In terms of figures given to estates they would be about 0.5 of a pH unit higher than those shown in the tables.

Table 3—*St. Coombs cultivated field compared to jungle*

Depth	Carbon		Nitrogen		Ammonia		Nitrate	
	Jungle	C. Field	Jungle	C. Field	Jungle	C. Field	Jungle	C. Field
0-6″	4.81	2.72	0.46	0.27	8	8	12	6
6-12″	2.45	2.67	0.28	0.27	3	8	6	6
12-18″	1.68	2.11	0.20	0.23	7	8	4	14
18-24″	1.55	1.59	0.16	0.18	8	7	3	5
24-36″	1.33	1.28	0.13	0.14	7	7	2	4
36-60″	0.81	1.04	0.08	0.11	5	8	2	3
60-84″	0.40	0.88	0.02	0.09	3	7	2	5
Average	1.91	1.75	0.19	0.18	6	7	4	6

The top six inch samples include the jungle mulch which partly accounts for the richness of the jungle sample. Cultivation has incorporated some of this mulch in the cultivated soil which in the 6-12″ and 12-18″ layers shew more organic matter than the jungle soil. Some of the jungle mulch will decompose rapidly in the early years after clearing.

Although the jungle mulch is biologically active and shows both high ammonia and nitrate in the top six inches the cultivated and manured soil compares favourably with it. The nitrate contents of soil vary very rapidly over quite wide ranges but where they are in excess of the crop requirements—be it jungle or tea—they may wash down to lower horizons.

The nitrate figures must be considered in conjunction with the demand made by the plants growing in the soil. It is also important to realise that the nitrates are not necessarily formed in the layer in which they are found, as, not being held by the soil like ammonia, they tend to wash down.

The really remarkable thing about the jungle soils I have examined is the very superficial root system of the jungle flora. Very few roots are found below 6 inches or one foot. The top six inches of soil is very dark and there is an abrupt change at 6 inches to the familiar red or yellowish red soil.

Virgin patna soils may be even richer than jungle soils where they have been left undisturbed and not burnt off every year. The grasses appear to root deeper than the jungle.

St. Coombs patna soil is very dark down to 2 feet depth. From 2 to 3 feet the soil is still dark and changes from brown to red below 3 feet. This change of colour corresponds very roughly to the root system. One of the apparently richest soils we have examined came from undisturbed patna land on St. Coombs. (Table 4).

Table 4—*St. Coombs patna.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	25.8	4.6	11.64	0.75	11	1
6-12″	27.1	4.7	5.68	0.40	9	1
12-18″	18.3	4.6	2.82	0.18	—	—
18-24″	12.6	4.6	1.75	0.12	—	—
24-36″	10.2	4.7	0.90	0.07	7	2
36-60″	13.3	5.0	0.51	0.02	—	—
60-84″	11.2	4.7	0.50	0.01	—	—

You will note that the top soil has something over 20 per cent. of organic matter in it. From the practical farming point of view it is really an acid heath soil and contains an excessive accumulation of organic matter. The nitrogen content is fantastic amounting to 15,000 pounds in the top acre six inches, equivalent to 75,000 pounds of sulphate of ammonia. The nitrogen is only very slowly available, the nitrate production rate being apparently very low. The growth of the patna flora, mainly grasses, did not suggest a very high nitrate supply. Tea clearings on such soils tend to make slow progress at first, but eventually may give very high yields.

Examination of fields, which have been opened up from patna land, indicates that the organic matter level falls considerably under cultivation when the original content is excessive. Patna soils require a good deal of detailed investigation for many are potentially good soils and some fine areas of tea have been opened up from them. My impression is that patna clearings are generally found to be 'slow starters' and this difficulty may possibly be overcome.

Before passing on to other areas it may interest you to see figures relating to a highly fertile soil from my garden which was opened from patna. (Table 5).

Table 5—*Garden soil, St. Coombs. Dark brown layer* 0-18″, 18″ *and below red soil.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate (Parts per million)
0-6″	24.85	5.5	3.48	0.301	5	16
6-12″	26.60	5.5	3.48	0.211	6	15
12-18″	27.50	5.3	3.32	0.304	5	12

A great deal of lime has been added to raise the pH to 5.5 and, although much cattle bulk and compost have been dug in during the past 20 years, the organic matter content is below 7 per cent. The rate of nitrate production is very high. There is little doubt that liming greatly accelerates the rate of breakdown of organic matter and the content of 7 per cent. in the garden soil has only been maintained by heavy manuring with cattle bulk.

Where the pH of soil is naturally high, due to the presence of limestone, the organic matter in the soil is very low. Table 6 gives figures obtained from a tea field in Welimada district where there is an outcrop of limestone.

Table 6—*High pH area—Welimada.*

Depth	Moisture %	pH		TOTAL ON DRY WEIGHT			
		H_2O	KCl	Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate (Parts per million)
0-6″	16.95	6.3	5.6	0.78	0.082	5	16
6-12″	18.75	5.9	5.2	0.61	0.062	5	4
12-18″	20.05	5.9	5.3	0.53	0.057	4	3
18-36″	22.95	5.7	5.2	0.47	0.061	4	5
36-60″	24.40	5.5	5.3	0.44	0.047	5	10
Below 60″	16.15	5.8	5.3	0.13	0.013	6	4

You will note two columns of pH figures, the first of which gives values with which you are familiar. The second column corresponds to previous tables. Nearly

all our published figures are for values measured in water and correspond to the first column.

The total carbon and total nitrogen figures are very low and nitrate production is very high, although the high figures may be partly due to drought conditions and dry soil. In spite of the high nitrate production tea does not thrive in soils of such high pH. Just why tea dislikes soil of high pH value we do not know, but Mr. Tolhurst suspects that it may possibly be due to the fact that manganese or aluminium, for both of which tea apparently has a very high demand, become unavailable in neutral or very slightly acid soils.

More will be said about lime in my next paper and Mr. Tolhurst will refer to the tea bushes' need for lime or calcium, but I ask you to engrave upon your memory here and now the effects of any considerable quantity of lime upon tea soils.

We will now examine figures obtained for highly fertile low-country soils. (Table 7).

Table 7—*Low-country high yielding area*—30 *years old.*
8-18″ *Dark layer.*
18-24″ *Lighter layer.*
24″ *and below yellow clay with red mottling.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	23.50	4.4	2.50	0.207	14	5
6-12″	22.50	4.3	1.94	0.145	11	5
12-18″	21.15	4.4	1.47	0.117	12	4
18-36″	22.80	4.5	0.76	0.072	11	30
36-60″	25.60	4.7	0.37	0.036	11	57
Below 60″	25.15	4.8	0.24	0.022	9	39

At the higher soil temperatures breakdown of organic matter is rapid and there is not the same tendency for accumulation of peaty matter as noted at the higher elevations. Nevertheless the content of 5 per cent. organic matter in the top layers is quite high and is maintained under good management.

Biological activity is intense and the production of nitrates is far in excess of even the requirements of a complete cover of high yielding tea and vigorous green manure and shade trees. Considerable quantities of nitrate are washed down to a depth of 60 inches and over. The yield of the area in question is approximately 1,400 pounds per acre.

Table 8—*Low-country jungle close to above area.*
0-12″ *Dark layer.*
12″ *and below yellow clay and red mottling.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	25.10	4.8	2.76	0.226	13	0
6-12″	25.00	5.0	2.24	0.172	12	0
12-18″	25.80	5.1	1.28	0.114	10	0 Less than one
18-36″	27.80	5.2	0.68	0.065	7	0
36-60″	28.65	5.2	0.36	0.036	8	0
Below 60″	27.50	5.2	0.31	0.028	8	0

Table 8 shows figures obtained from nearby jungle soil and from these it is evident that thirty years of high yields under good management have had little effect on the carbon and nitrogen status of the soil. The low nitrate in these jungle soils, which has been recorded on more than one instance, is probably due to the vigorous jungle growth which snaps up nitrates as soon as they are formed. The jungle in question is a secondary growth and is a tangled mass of vegetation. Figures for primary jungle comparable to the up-country figures given earlier are not so far available.

Now we will go to the other extreme and examine figures obtained from poor thin tea fields in the low-country at 350 feet elevation (Table 9) and up-country at 5,000 feet (Table 10).

Table 9—*Low-country. No marked horizons. Poor thin tea yielding* 400 *lbs. per acre.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	7.8	4.3	1.06	0.091	11	3
6-12″	9.0	4.3	1.12	0.077	11	2
12-18″	7.1	4.3	0.83	0.050	9	1
18-24″	7.3	4.3	0.67	0.032	8	1
24-36″	7.2	4.3	0.47	0.023	8	1
36-60″	3.7	4.5	0.38	0.010	8	1
60-84″	8.6	4.5	0.60	0.029	11	1

In the low-country the organic layers have either eroded or oxidised away and have not been replaced by leaf-fall, mulch and root activity. The soil ammonia is still high, but nitrate production is very low, especially in view of the poor growth.

Table 10—*Up-country.*
0-12″ *Dark layer.*
12″ *and below yellowish clay.*
Poor thin tea yielding under 300 *lbs. per acre.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	16.9	5.2	3.32	0.233	19	2
6-12″	17.3	4.6	2.34	0.124	14	1
12-18″	22.2	4.5	1.18	0.097	10	1
18-36″	16.5	4.7	0.67	0.053	8	1
36-48″	13.0	4.8	0.64	0.029	7	0
48-66″	15.2	4.8	0.58	0.024	8	0

In the up-country soils the organic matter has persisted and is in fact rather higher than in nearby jungle. Ammonia is especially high, very much higher than in the jungle. Nitrate production is, however, very low in spite of low demand from the tea which yields under 300 lbs. per acre.

The low-country soil has deteriorated without doubt, and will require rejuvenation, probably by a period under a grass such as Guatemala grass. The up-country soil has all the appearance of having grown lazy and after studying the area for some time I have come to the conclusion that some hard working tea bushes would

put it right. The area in question is rather exposed to wind and heavy rain which is too much for the present debilitated tea bushes. Replanting such an area is problematical, but an experiment in the area will be most interesting. My impression is that vigorous clones under a good stand of shade trees with carefully sited wind-breaks will do well in the area. Since I wrote this talk, however, Mr. Tolhurst has found some evidence of a possible shortage of magnesium and I think you will find his lecture this afternoon to be of considerable interest. Up-country soils show remarkably little evidence of deterioration under the most adverse conditions. Below about 3,000 feet there is apparently a tendency for soils to deteriorate more rapidly unless they are kept under a good cover of tea. Declines at lower elevations are of a vicious type because poor tea may beget poor soil.

Finally some figures from a Gampola small holding are of very great interest. (Table 11).

Table 11—*A Gampola small holding.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrate
0-6″	11.4	4.6	0.82	0.073	4	3
6-12″	12.6	4.6	0.49	0.051	3	14
12-18″	13.4	4.7	0.26	0.031	3	19
18-36″	13.7	4.8	0.10	0.017	4	24
36-60″	10 55	4.9	0.09	0.011	3	13
Below 60″	12.7	4.9	0.02	0.009	3	10

The tea is alleged to be 80 years old and there are about 700 bushes per acre growing on bare scraped soil. There is of course no horizon to be seen as the top soil has undoubtedly been scraped and eroded away.

I can only describe it as a noble soil putting up a gallant struggle.

Soil temperature conditions, especially under full exposure to the sun, will be high and the organic matter is rapidly oxidising away. The nitrate production is remarkably high but there are so few plants to use it up that it washes down to the lower horizons. Even after such criminal abuse it would probably improve quite rapidly under reasonable management.

Table 12—*Abandoned tea and mana grass.*

Depth	Moisture %	pH	TOTAL ON DRY WEIGHT			
			Carbon %	Nitrogen %	Ammonia (Parts per million)	Nitrates
0-6″	9.7	4.5	0.50	0.040	3	1
6-12″	11.2	4.6	0.23	0.022	3	2
12-18″	11.5	4.7	0.12	0.011	2	2
18-36″	11.4	4.7	0.13	0.012	4	2
36-60″	18.7	4.9	0.13	0.014	4	2
Below 60″	23.9	5.0	0.07	0.014	4	2

Table 12 shows a more advanced case of deterioration in the same area where the carbon content is down to 0.5 per cent., *i.e.* about 1 per cent. organic matter. Mana grass has become established for the past 20 years but is of course burned off at frequent intervals. Erosion continues between the grass clumps especially after burning. Nevertheless the grass is taking up the nitrate and would return it to the soil, and build up the organic matter if it were not burnt.

The soils from the north east monsoon area gave very much the same picture as the soils I have described. None of the patnas were anything like so rich as the St. Coombs patna described earlier, but in every case there was a history of burning or disturbance for food production and we could not describe them as virgin patna.

The survey of carbon, nitrogen, ammonia and nitrate contents has, I think, given very useful results and enables us to draw some general conclusions. I hope the survey will be continued and that many other characteristics will be measured, especially the general nutrient status and the total capacity for storing nutrients. It is, however, a long and tedious task and to have attempted too much in the preliminary survey would have confined our efforts during the year to St. Coombs or the up-country south west zone at the outside.

Later in the Conference other aspects of replanting besides the planting material and the soil will be considered. Eelworm, root diseases, and shot-hole borer all have to be taken into account, but from the Agricultural Chemist's point of view I think it can be fairly said that we are blessed with remarkably good, stable and tolerant tea soils. After a very long period of monoculture there are few signs of deterioration, at least at higher elevations under the estate system of management, and there are no apparent reasons why replanting with selected material should not be a great success.

Below 3,500 feet it is particularly important to maintain a cover over the soil, but where the history of management has been a good one this supports rather than opposes the case for replanting with vigorous, spreading types of bushes.

THE FUTURE OF DISEASE CONTROL AND PREVENTION WITH PARTICULAR REFERENCE TO REPLANTING

B. N. Webster

At the outset I want to assure you that I am not introducing any new or alarming subject on this occasion. Having, at the last Conference, treated you to a very theoretical dissertation, I propose today to be strictly practical.

Continuing the emphasis on the future, it is my intention to deal with some of the opportunities, offered by replanting, to minimise losses through disease, and I propose to begin with root diseases.

The beneficial results to be achieved by crop rotation have been known for thousands of years, the principal advantage from a pathological point of view being the elimination, or reduction, of diseases peculiar to the crop under cultivation. Root diseases such as Poria, which bother us at the moment, are a direct legacy from the original jungle, which was planted up immediately after felling, and they have been passed on from bush to bush since that time. Now uprooting of tea is a costly business, and no-one can afford to spend the time, or money required to remove every root. Modern methods of winching leave fewer roots in the soil than does forking out, unless the latter is very closely supervised, and done so carefully as to be uneconomic, but nevertheless there are always sufficient left in to form a focus of infection. We have recently had a very good example of this on St. Coombs new clearing. The majority of this clearing was under Guatemala grass for eighteen months to two years, and then *Tephrosia vogelii* was planted on the contour, followed, when established, by tea. A small block of ½ acre was deliberately planted up within a few months of uprooting the old tea, as soon as some Tephrosia had become established. Within a year, in quite a large area of this block the Tephrosia plants were dying out with Poria infection, and so the whole of this area had to be thoroughly cleared one more, and Tephrosia re-established. A careful search in the remainder of the field (some 6 acres) has failed to show any signs of Poria root disease, and this in a field which had quite a number of Poria patches prior to uprooting. The explanation lies in the fact that the Poria fungus has, after two years, exhausted the supplies of food in the small portions of root left in the ground, and although able to travel through the soil from a food-base it is unable to exist on soil alone.

Poria is not the only disease organism capable of leading a saprophytic existence on dead wood, and *Fomes noxius* (Brown Root Disease), Ustulina and Rosellinia, although unable to make free growth through the soil, can infect young tea by contact. In the event of our ever receiving any encouragement to replant old rubber land in tea a two year fallow will be of equal importance, as three of the troublesome root diseases of rubber, Fomes, Poria and Ustulina, are also able to infect tea.

The order of work then, when replanting, should, in our opinion, be as follows :—

(i) Removal in any case of as much of the root system of tea bushes and rubber stumps as possible.

(ii) Brief examination of all stumps removed, and hand clearance of the roots of any found to be infected by a root disease.

(iii) Planting up of the areas, for two years if possible, with a non susceptible cover. Guatemala grass has proved very effective so far for this purpose, as it also improves the soil conditions, whether this is strictly necessary or not.

(iv) Planting up of a good indicator plant such as Tephrosia before establishing tea. If grass is decided against, this may be used from the beginning of the clearing.

(v) The re-clearance of areas where the Tephrosia dies out, followed by re-seeding, until a clean stand is established.

(vi) Replant with well grown tea plants.

The special case of land infested by eelworm will be dealt with by Mr. Loos.

The other severe scourge of tea, particularly of low-country tea, which may to a great extent be minimised by taking a little thought after replanting, is wood-rot. In a great majority of cases, seen time and time again in young plants, the wood-rot originates at the centering cut, and at the further pruning cuts made when bringing in the bushes. The use of rational methods of bush management in bringing in, stressed so heavily by Mr. Walter in his last conference address, will do much to avoid repeating that picture of decrepitude so common in a great deal of to-day's tea.

There is one other aspect of replanting particularly important from my point of view, which results from the known variation in susceptibility to disease of different tea clones. It is patently impossible to replant entirely with the ideal clone, even if such a thing existed, and so one must be content with a mixture of clones, all, we trust, high yielders, but not all blister resistant, or resistant to other pathogens such as yellow-mite, eelworms etc. which my colleagues will deal with. I am strongly in favour of the block planting of clonal material, say 1-2 acres of each clone, rather than mixed planting, or the planting of a whole field with one clone.

The reason is obvious, and two examples will serve to illustrate this.

With a number of clones which are blister resistant, and a number which are susceptible, mixed planting would entail protection of the whole area, whereas with block planting only those susceptible clones need receive protection. Again, and this is most important, we never know when a new disease may arise, and should one appear that favours a particular clone, limitation of its spread would be much simplified by block planting.

There are several questions which one is often asked about the future of certain diseases. Principal amongst these is blister blight, and I will say, without much fear of being contradicted, that blister blight is here to stay! Again, replanting affords us the opportunity of choosing highly resistant clones for planting up. That these should be tested and approved in the district for which they are intended is most important, as a clone resistant in Galle might not be resistant in Nuwara Eliya. This has just been demonstrated for rubber clones and oidium, and there is no reason why it should not be found to apply to certain tea clones also.

The ultimate perfection in protection from blister blight has by no means been reached as yet, and if one is not replanting resistant material then the opportunity is offered, by replanting, of adopting new field layouts to facilitate the use of any

new (possibly mechanised) equipment, which may be developed. Whether equipment should conform to style of planting adopted, or planting conform to existing equipment, is a matter for future discussion.

There is a popular fallacy at the moment, that either resistant clones will lose their resistance after a while, or that the fungus will increase in virulence. As far as I can say at the moment there is little likelihood of either of these things happening, but a proposed investigation into the life-history of the blister blight fungus may help us to give a more definite answer. The chief reason for belief in this fallacy is complacency, with a consequent falling off in the standard of supervision of protection.

The second question occasionally asked is what is, the future of the phloem necrosis disease, and is it likely to appear in new clearings. Firstly, we believe at the moment that it has little effect on high jat material; so, provided replanting is done with such material, as it should be, there is little chance of its being troublesome. Secondly, as we suspect that it is passed on by root contact and graft of living roots, a year or two of fallow, as already advised, enables root suckers to develop, so that they can be seen, and all living roots capable of passing on infection can then be removed from areas where necrosis was endemic.

One small point about thatching, before I conclude. This is a growing practice, and an extremely sound one, but there have been one or two cases of Rosellinia disease spreading through thatch on new clearings, so I would urge that thatch, particularly when jungle cheddy is used, is confined to the inter row space, and not piled up around the collars of the bushes.

To conclude—the future plans of the Mycology Department will be aimed, as always, at improving disease control, but we cannot too strongly urge that prevention is so much better than cure, and prevention depends to a large extent on early recognition of symptoms by you. So do please make every effort to familiarise yourselves with the symptoms of the commoner pests and diseases, and leave us time to really help you.

EELWORMS

C. A. Loos

The question may well be asked how serious and widespread is the damage attributed to meadow eelworm in Ceylon tea plantations. So far as our records show the pest is confined to the up-country districts where the crop over many thousands of acres is almost exclusively tea. The haphazard and light distribution of the eelworm, at the time tea was planted, has built up over many decades, on a very susceptible crop, and has extended considerably. In certain areas the damage caused by the pest is causing anxiety, while there is undoubted evidence that distribution over the tea districts is far more extensive today than it was 25 years ago.

The movement of the pest in soil is slow, but as tea has to remain with us, as a permanent and almost a monocultural crop, little can be done on infested estates to check the gradual spread from foci of infestation to surrounding bushes. Under these conditions what may be considered a mild pest today may assume serious proportions fifty years hence if cultural practices are not carefully maintained.

The possible nature of damage may be assessed from crop records over a field of 48 acres on an estate where infestation is both severe and widespread. Between 1921 and 1928 the average yield was approximately 1,200 pounds of made tea per acre. Between 1946 and 1953 the yield fell to below 300 pounds per acre. On another estate, in a different district, where infestation is also widespread, the yield over the whole estate fell from 800 pounds per acre in 1940 to just over 400 pounds in 1953.

Losses due to meadow eelworm attack may be assessed from counts of productive bushes on a heavily infested estate. Over an area of 225 acres a count of productive bushes, on plantings $3 \times 3\frac{1}{2}$ feet, averaged 1,300 bushes per acre. This count included bushes which carried even a few flush points and, therefore, includes a fair proportion of sick plants in the process of deterioration. An average yield of 300 pounds per acre is not surprising under such conditions.

The damage to tea caused by meadow eelworm attack is in the destruction of feeding roots with the resulting check in the absorption of plant nutrients. The bush gradually becomes unproductive and eventually fails to recover after the usual pruning.

An important field of eelworm research, in other countries, has been in the analyses of plant material, including stems and roots of certain plants for their mineral content. Significant increases or decreases of many of the essential elements including sodium, potassium, phosphorus, magnesium, copper etc., have been found as a result of eelworm attack. In many cases the deficiencies continued, even though these elements were supplied to the plant, but on elimination of the eelworm pest conditions returned to normal.

Control of damage caused by plant parasitic eelworms by heavy applications of organic matter has been established in a number of countries. Sugar beet may be grown successfully in soil heavily infested with the sugar beet eelworm if the area is heavily dunged before planting. Similar results have been observed for tea where heavy applications of bulk material caused a remarkable recovery of the plants in health and vigour. The soil has, therefore, to be kept rich in decaying organic matter if gradual deterioration to unproductiveness is to be avoided.

Little is known of the origins of the meadow eelworm though there are indications that the pest is fairly widely distributed in patna soils. The chief agent in the spread of the pest and in the setting up of new foci of infestation in tea is man. Plants

transferred to the field from an infested nursery would carry the pest with them and so distribute the eelworm over land which previously may have been free of the pest. For this reason I have repeatedly advised against the distribution of clonal material, as rooted plants, from one estate to another. Nurseries are the focal point at which control measures must be adopted. Fumigate the nursery beds before each planting and do the fumigation efficiently. Do not transport soil indiscriminately to your nursery. If soil has to be brought in from outside fumigate it before the nursery is planted. If your estate has no previous history of meadow eelworm infestation keep it clean by planting clean material. Do not import rooted plants from other estates.

What can we do to minimise the possible build up of parasitic eelworms on areas to be replanted and in new clearings?

From experiments conducted in my laboratory it has been proved beyond any reasonable doubt that the meadow eelworm is an obligate parasite. In other words the pest requires a living root of a susceptible plant in order to propagate its species. We have found that after starvation (that is withholding of living roots from the pests) for 18 weeks, 20 per cent. of the worms were still alive. However, as the period of starvation progressed the worm gradually lost its ability to enter roots and after 20 weeks starvation this ability was lost completely. The presence of decaying roots in the soil did not materially preserve the worm's ability to attack susceptible roots.

Before replanting, therefore, it is desirable to fallow infested land for as long as possible, taking the precaution of avoiding undue exposure of the soil to the elements by thatching with Guatemala or Mana loppings. The area should be clean weeded frequently to remove roots of living plants on which the eelworm may feed. This is, of course, counsel of perfection and over large areas is not easy. The odd weed must persist here and there to bring about the condition of haphazard and light distribution which probably prevailed at the original planting. The prevention of reinfection is also a major problem unless large areas are fallowed simultaneously. The possibility of reinfection from drainage water and other sources is also not easily controlled.

After a year of fallow the area should be planted up with Guatemala grass, *Desmodium gyroides*, *Crotalaria usaramoensis* or *Crotalaria anagyroides* which are not susceptible to meadow eelworm infestation. A period of two years should, therefore, lapse between uprooting of infested tea and replanting in order to eliminate the pest as far as possible from the area to be planted. Where meadow eelworm infested land has to be planted in tea do not plant *Tephrosia vogelii* until the two-year period is over, as it is a very susceptible crop.

The most important requirement, where the possibility of reinfection remains, is in the selection and propagation of eelworm tolerant material. Testing of tolerance is a long term project as many complex characters of soil conditions have to be contended with. For instance T.R.I. Clone 2024 established in a lightly infested nursery has grown excellently on transference to an area which was free of meadow eelworm. The plants are now just over 7 years old and, though the root system supports a large population of the pest, have produced a crop of 3,900 pounds of made tea per acre over a period of 12 months. However, attempts to establish the same clone from cuttings in heavily infested soil have failed, though cuttings from apparently tolerant bushes have grown remarkably well under the same conditions. On the other hand T.R.I. Clone 1294 which was established successfully in lightly infested soil grew excellently for 7 years and then succumbed in a few months' time. For the proving of tolerance it appears desirable to grow selected material under conditions of heavy infestation, from the cutting stage, for a period of many years before the final selection is made. Work on these lines has already commenced and over 100 selections are under test. Whether we can find clones which are resistant to both meadow eelworm and blister blight disease only time will show. Blister can be controlled by chemical means at an economic cost, but the control of eelworm pests chemically in a standing crop is still a nematologist's dream.

INSECT PESTS AND REPLANTING OF TEA

B. A. Baptist

The importance of insect damage in new planting is especially significant because at the stage of early vegetative growth, when the plant is in the process of establishing itself, a set-back, as may be caused by insect injury, may lead to a permanent stunting of the plant, which in turn may have serious consequences on subsequent yield. On the other hand, optimum cultural conditions generally make actively growing plants withstand insect attack without being seriously set-back thereby, and the provision of such conditions is an important, indirect method of economically controlling insect injury.

Insect pests that may be met with in replanting are numerous and varied, but only a few are of any importance. The earliest pests one comes across are those present in the soil. These are white grubs, cut worms and termites.

The root-eating white grub is the larval stage of a cock-chafer beetle, the commonest ones on tea estates being species of *Anomala*. The adult beetles feed on Albizzia and other trees, but lay their eggs amongst grasses. On hatching out these grubs feed on the roots of the grasses but do not generally cause any noticeable symptoms. When the grass is replaced by tea or other plant the grubs migrate from the dying grass roots to the roots of these plants and by their feeding quickly bring about their death.

Control can be effected in two ways:—

(*a*) Culturally, by a thorough cultivation or forking of the soil done prior to planting so that all grubs are removed or exposed. All undecomposed vegetable matter in the soil is also removed at the same time and the ground left fallow for 4-6 weeks.

(*b*) Chemically, by an application of a soil insecticide made just prior to planting, so as to destroy all grubs present on the original grass roots. The most effective insecticides which can be used for this purpose are chlordane and aldrin.

Cutworms are caterpillars which hide in the soil during the day coming out at night to feed on young seedlings or tender plants which they cut off at ground level. As the plant gets older and harder they are not able to cause any damage and are, therefore, pests only in the early seedling or nursery stage. They can be controlled by the application of soil insecticides as recommended for white grub.

Termites frequently found in new clearings are of the scavenging type having often been attracted by the roots or stumps of dead trees. Their importance lies in the fact that they destroy the material or thatch laid down to cover the soil and in some cases the seed when it is planted *in situ*, or any dead tissue on the plant. They are not normally primary pests and do not attack healthy, living plants. Digging up or destroying evident termite mounds and removal of dead wood normally eliminates such termites: so does the application of soil insecticides. The resting of the area under a fresh crop like Guatemala grass, as already advocated by Mr. Webster and Mr. Loos for eliminating soil borne diseases, can also serve indirectly to eliminate the termites in the locality.

A common pest of new plantations is the red borer, a stem-boring caterpillar which lives and feeds inside the stem, tunneling through it and causing eventually the wilting and death of the plant or the branch affected. The frass of the caterpillar is often extruded through a hole in the stem and may be evident long before

wilting occurs. Control is effected by regular, periodic examination of the plants for the removal and destruction of the borer.

Another very important pest factor in tea cultivation, though not an appreciable factor in new clearings, is that of mites, the most important of which are the yellow and scarlet mites. They have appeared in the past from time to time without being very serious, but recently they appear to have persisted for very long periods in certain areas, causing very serious defoliation and loss of crop. The reason for this is still not clear, but it is likely that it is due to a combination of various factors. Heavy infestation of shade trees, especially Grevillea and Albizzia, by scarlet mite, has further complicated the position with regard to the control of this mite. Sulphur as a spray or dust is still the most effective acaricide but it has a great disadvantage in its strong tainting properties, which necessitate the discarding of crop for a period of 3-4 weeks after application. Other acaricides which cause less tainting are, therefore, being tried out and of these chlorobenzilate appears to be promising for use against scarlet mite.

The shot-hole borer (*Xyleborus fornicatus* Eich.) is the most important pest factor which one has to deal with in tea cultivation. This insect has been said to cause die-back of branches, poor development of frame, increase in susceptibility to wood rot, great reduction in yield and by some observers even death of the bush especially after pruning. Other factors can also bring about very similar effects, but wherever these effects are most severe, shot-hole borer incidence is also very high. In such cases the shot-hole borer has been considered to be the key which locks the door to the normal recovery of the bush or improvement in the yield of the crop. In new clearings its effect is perhaps not so conspicuous, but it may occur after the second year in quite appreciable numbers. When it does it brings about a set-back in the initial development of the bush which may have serious consequences on subsequent yields.

Work done in the past on this pest, which has been largely confined to the Uva district, has shewn that a lengthening of the pruning cycle to 3 or more years, coupled with adequate manuring, has greatly minimised the amount of damage caused. In most districts in which these cultural methods are practicable, and where they have in fact been given effect to, the set-back to development or yield on account of the pest is negligible. In other areas such cultural measures have not been practicable or effective.

A parallel line of investigation is the physiological one, namely that of plant resistance or immunity of the plant to attack by the pest. Some difference in susceptibility in various clones has been noticed and this line of investigation will also receive attention.

Attention has also been paid to the biological control aspect, namely, the search for parasites or predators of the pest, but nothing promising has yet been found.

In the past year or so, we have begun to explore the possibility of using insecticides to control this pest and this may turn out to be a practicable line of action in new clearings and perhaps even in areas with short pruning cycles. Most modern insecticides have been tested against the shot-hole borer and many, including D.D.T., benzene hexachloride, aldrin, dieldrin, have been found to be effective in killing shot-hole borer on direct application to infested branches. Routine, repeated applications, throughout the cycle, however, as is at present necessary to give appreciable control, are neither easy to effect nor appear likely to be economically feasible. Much work has, therefore, still to be done before definite recommendations on insecticidal control can be made. Further, it has to be remembered that insecticides are a two-edged sword and however effective they may be in killing the pest in question, they have also to be carefully investigated from the point of view of upsetting the biological balance by the simultaneous destruction of beneficial parasites, which may release some other pest factor hitherto under proper control.

My appointment, as Entomologist, to the Institute, is closely connected with the urgent need for intensive work towards solving the problem of shot-hole borer, which will be my major task, with the mite problem forming a not unimportant second.

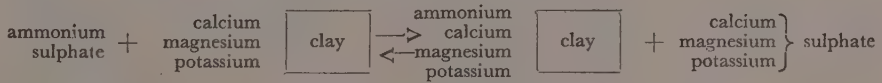
CHEMICAL AND BIOCHEMICAL INVESTIGATIONS ON CEYLON TEA SOILS

J. Lamb

Before explaining some particular aspects of our soils which I think urgently need investigation if we are to maintain high yields from areas replanted with vigorous clones, I will remind you of some of the more important general properties of soil.

The easiest way of explaining one of the most important properties of soil is to compare it with a domestic water softener. The domestic water softener is a cylinder connected with the water main on one side and the taps on the other. It is filled with nodules of a base exchange compound. The hard lime and magnesium bearing water passes through the nodules and the lime and magnesium are largely replaced by sodium which does not give water the property of hardness. When the nodules are exhausted or saturated, the cylinder is flooded with a strong solution of sodium chloride, best known as common salt, and the calcium and magnesium are again replaced by sodium. The softener is thus regenerated and ready for use again.

If a solution, roughly equivalent to that which will result from the solution of sulphate of ammonia in rainwater after manuring, is passed through a cylinder of sand, unchanged ammonium sulphate solution will drain away. When the same solution passes through a cylinder of good soil, the greater part (not all) of the ammonia is held by the soil and the drainage water contains mostly sulphates of other bases such as calcium, magnesium and potassium.



This capacity which soil possesses for holding nutrients is known as base exchange capacity and may be measured with some accuracy.

Both clay and organic matter possess this property. The type of clay found in our soils has, however, only about a twentieth of the capacity which other clays in some good arable soils have for holding nutrients and the organic matter is possibly therefore relatively more important. More detailed work is required and I hope that a survey of base exchange capacities of our tea soils will be possible in the near future.

Since tea soils are acid, the total capacity of the clay and organic matter for holding bases, such as calcium and magnesium, is only partly saturated. The parent rocks are relatively poor in these elements and whenever we add sulphate of ammonia we cause some loss of calcium, magnesium and potassium. In good arable soils the loss of exchangeable calcium is made good from reserves contained in minerals in the soil. In tea soils there is very little calcium, either in the exchangeable form or as reserve, and we have recently found that ammonium sulphate causes mostly potash to be displaced which is then lost as potassium sulphate. We are, of course, adding potash in the manure but it is a much more expensive mineral

than calcium or lime and we are beginning to think in terms of limestone as a possible potash economiser. Apart from the aspect of economising the use of potash I am frankly alarmed by the very low reserves of calcium and magnesium and Mr. Tolhurst will later give additional information which does nothing but substantiate my fears.

In a recent article in the *Tea Quarterly* Mr. Tolhurst and I pointed out that the calcium phosphate in saphos phosphate is a source of lime and magnesium as well as phosphate. 50 per cent. muriate of potash is also another source of magnesium but the more highly purified salts contain less magnesium. Even with a certain amount of calcium and magnesium in T.R.I. 500 mixture we appear to be dangerously near 'scraping the bottom of the barrel' so far as these two elements are concerned. Acid soils in high rainfall tropical areas, especially those derived from acidic rocks, are at the best of times low in calcium and magnesium and cultivation will do nothing to improve their status.

We have recently carried out some analyses of the total content of calcium and magnesium in a typical profile (Table 1). This total content includes exchangeable or easily available fractions, which are in fact scarcely detectable, as well as the content in clay, organic matter and unweathered minerals. It was obtained by dissolving soil completely in a powerful acid known as hydrofluoric acid and the method is difficult and expensive to apply to extensive analysis. Curiously enough the content of the upper layers of soil, certainly in the case of calcium, is higher than the content of the sub-soil. It is not what we expected to find and we cannot explain it.

Table 1—*Content of calcium and magnesium in parts per million of dry matter.*

Depth inches	Calcium (Ca)	Magnesium (Mg)
0-6″	677	2180
6-12″	555	1911
12-24″	460	852
24-36″	310	764
36-60″	380	895
60-84″	250	1114

Note 677 p.p.m.=0.0677%

At the present rate of carry off of calcium, in crop and prunings alone, the top soil contains only sufficient of the minerals to last for 40 years. Some loss of calcium in the drainage water is inevitable and is increased every time we use sulphate of ammonia as a manure. The reserves locked up in the mineral particles will not of course become completely available in anything but geological time, and it does appear that calcium supplies need very close investigation. The soil reserves of nitrogen are far higher than those of calcium and it is just as essential to ensure calcium supplies as it is to ensure nitrogen supplies. For all we know at present, limitation of available calcium and magnesium may be restricting growth. The magnesium status is somewhat better than the calcium status but is nevertheless low enough also to require close investigation. An industry of the size of the tea industry should have a central research organisation staffed and equipped to ensure against future troubles. The aim of research should be primarily prevention and not cure.

It has been known for some time that potash has not only been held as exchangeable potash but that in certain clays some of it is held much more firmly; to the

extent of becoming fixed and unavailable to plants. The fixation of potash is aggravated by wetting and drying of soils and is one reason why manure should always be applied when rain is, as far as one can see, likely to follow application and why manure should be dibbled or forked into the soil.

More recently it has been established in Trinidad that, at least in a number of tropical soils, a proportion of ammonia also becomes fixed. This work was published just as we were coming to the same conclusion with regard to Ceylon tea soils (Table 2) and partly explains some of the very high nitrogen contents of our soils described in my previous paper.

Table 2—*Percentage fixed ammonia in St. Coombs profile.*

Depth of soil	Percentage of fixed nitrogen (mainly ammonia)
0-6″	5.3
6-12″	6.7
12-24″	18.2
24-36″	10.7
36-60″	14.3
60-84″	11.1

Whether or not nitrifying organisms have any access to this fixed ammonia is very doubtful. Just how long soils can go on absorbing ammonia in this way remains to be discovered. Presumably there is a saturation point.

It is probable that alternate wetting and drying increases fixation of ammonia as it does potash and makes it even more important to keep the soil moist and to avoid frequent drying of the top layers. There is, as you will now realise, a tremendous amount of research to be done on the chemistry of our soils.

Next I will give you some account of the investigations into the chemistry of biological processes which take place in our soils, *i.e.* soil biochemistry.

As many of you are aware most plants have a limited ability to take up ammonia directly and that ammonia has to be 'nitrified' in the soil, that is to say, changed to nitrate. We are now attempting to find just how the tea bush takes up its nitrogen requirements.

In the first place the ammonia content of our soils, as revealed by the soil survey, is naturally high, yet tea undoubtedly responds to manuring with sulphate of ammonia. I may as well confess that we are no nearer to an explanation of this curious fact than we were when we started investigation, but we have discovered a number of quite interesting things and no doubt patient research will eventually sort the complicated tangle of factors out into some sort of shape.

Closely to study the nitrogen requirements of the tea bush we constructed some lysimeters about eighteen months ago. For some time the lysimeters containing the tea bushes were manured with everything the bush could require except nitrogen. The drainage from the lysimeters containing bushes contained much less nitrate than those containing soil only. The ammonia in the drainage water was the same in both cases. This suggested that the bushes took up nitrate.

Eventually the bushes became very yellow and showed every sign of nitrogen starvation. The soil at this stage contained 14 parts per million of ammonia in an exchangeable and apparently freely available form. The total nitrogen content of the soil was 0.269 per cent.

When nitrate was added the yellowness disappeared in a few days at quite remarkable speed, and even old leaves made a gallant attempt to recover. This appeared to be fairly conclusive evidence that tea takes up its nitrogen as nitrate but it is never safe in research work to jump to conclusions. All I can say at the moment is that we have failed to keep the bushes vigorous and healthy with a complete manure containing nitrogen as nitrate only.

Now although ammonia is firmly held by the soil, nitrates are not, like sulphates, chlorides, etc. held by base exchange (they are acidic and not basic). Nitrates normally wash out of soil quite rapidly, and we expected to collect the balance in the drainage water from the lysimeters. After we had added considerable quantities of nitrate, recovery in the drainage water and response in the form of new growth was poor. We decided to wash the lysimeter through and attempt recovery of the nitrate. To cut a long story short, most of it had disappeared but we do not think it has been lost as nitrogen gas; it is probably in the lysimeter still, as protein in some fat bacteria and fungi, and as ammonia.

This illustrates the particular need for basic research under tropical conditions. According to the text books, based largely on work on temperate soils, the reaction is a slow change of ammonia to nitrite, followed by a very rapid change of nitrite to nitrate. This reaction does occur to some extent and we find small quantities of nitrite, but the text books tell us little about the reverse process of nitrate to ammonia. We have to work this out ourselves.

It would take me a very long time to explain the work we have already done in any detail. It is quite obvious that a number of reactions involving chemical, bacterial and fungal changes are constantly taking place in our soil and I can only give you a brief summary of what we have found.

(1) Aeration in collecting top soil for experimental purposes stimulates the production of ammonia from the organic matter in the soil within two weeks but the effect soon disappears. Some of this ammonia may be converted to nitrate but certainly not all. As would be expected, additions of green manure and ammonium sulphate also increase ammonia production but the ammonia level returns to practically normal in four months. Lime appears to reduce ammonia production. (*Note.*—Even the disturbance of soil in sampling upsets its biochemistry).

(2) Disturbance and aeration in collecting top soil has little effect on nitrate production. There is no rise in nitrate content within two weeks of aeration as in the case of ammonia content. The addition of ammonium sulphate, green manure or lime has no effect within two weeks. All three, however, stimulate nitrate production within four months. Green manure plus ammonium sulphate and lime plus ammonium sulphate both have a very marked and practically equal effect. Lime alone has slightly more effect than sulphate of ammonia alone. Sulphate of ammonia alone nitrifies more quickly than green manure alone. The amount of lime added in these experiments was not enough to effect the pH of the soil and it is obvious that small quantities of lime have a beneficial effect upon nitrification. Please however remember the effects of excess lime described in my previous lecture.

(3) Compared with published results for other soils, the nitrification rate in Ceylon tea soils is very low. Lack of aeration not only arrests nitrification in top soil but may cause loss of nitrate. There appears to be very little nitrification in soils collected at a depth of more than 12 inches and the production of nitrate is not markedly stimulated by aeration or addition of lime. This is something more fundamental than lack of nitrifying organisms because inoculation of sub-soil with top soil has very little effect upon the rate of nitrification even when the inoculated soils are incubated at the temperature most favourable to nitrification.

(4) Nitrate added to top soils under conditions of low aeration, especially high moisture content, rapidly disappears. There is a corresponding rise in the ammonium content of the soil but not sufficient to account for all the nitrate. If nitrate is likewise added to soils collected from below 12 inches depth it remains unchanged and does not disappear in the same way as it does in top soil.

Mr. Webster has examined some top soils. He found the samples contained a rich flora of soil fungi, especially those of the Penicillium group. The most probable explanation of the disappearance of nitrate is therefore that it has been used by soil organisms. We must not conclude too much from this, but if the fish for lunch has disappeared, and the cat is washing herself and purring, we naturally have suspicions. When these soil organisms die and decompose some ammonia is no doubt liberated. Part of the nitrogen will almost certainly be locked up in some form of humus produced from the decomposition of the fungi and this may explain the build-up of organic matter in our soils.

Referring again to the lysimeters we find that in very wet weather the drainage water shows increased ammonia parallel to the loss of nitrate added as manure. Under conditions of light rainfall the ammonia content of the drainage water falls to a very low level. This strongly supports the laboratory findings.

General Conclusions

The only practical conclusion which can so far be drawn from this work is that the top foot of soil must be managed with all possible care and skill. First it must be protected from drying out, especially alternate wetting and drying. A good cover of tea is the first essential. Shade trees and green manures must be skilfully used to supplement the cover and contribute to surface mulch. Thatch, carried in from waste areas and ravines adapted to the production of grass and other green stuff, can be most usefully employed in thin areas.

The pruning mulch is a most important protection in the bare period after pruning. I venture the suggestion that manure stirred into a moist mulch before rain will be more usefully employed than manure put in by envelope forking. At the present moment I cannot see how any sulphate of ammonia forked in deeply—if it is actually ever achieved in the field, can be utilised by the tea bush.

Secondly, this active top layer must be kept open, well aerated and freely drained. Personally I have little faith in the fork for any sustained effect. One good tea bush and one good shade tree with vigorous root systems are in my opinion worth fifty forkers. The fork must be used with skill and discretion as a means to an end, the end being that root action will eventually take over the job of the forkers—what may be called 'rootisation' of forking. Feeding roots will aerate and deep roots will drain. Channels formed by rotting roots of shade trees cut out in rotation will materially assist drainage.

Once this soil attains a good structure, and organic matter is vital to structure, it will stay open, aerated and drained. Our soils have a naturally good structure which is destroyed by excessive cultivation. If you do not believe me, go and look in the jungle, where you will find that surface mulch and good cover go hand in hand with good structure and free drainage. Alternatively, come and look at St. Coombs estate, where persistent efforts to practice these ideas is undoubtedly having the most beneficial effects.

The more theoretical conclusions or perhaps I had better say indications, for the work is in its early stages, are that fungi play an important role in Ceylon tea soils. There is little doubt that decomposition of organic matter is intended by nature to take place on the surface of our soils, for there is a remarkable scarcity

of small animals, worms and insects, which on other types of soils are doubtless intended to incorporate organic matter in the soil. The downward movement of organic matter must I think be largely achieved by the passage of decomposition products from surface fungi to other organisms at lower levels, which, in turn, flourish, die and humify.

Nitrifying bacteria, which are difficult organisms to isolate and identify, appear to take some part in nitrifying processes, but they are generally supposed to be intolerant of acid conditions. It is not improbable that fungi stimulate them to some extent by production of ammonia which, being alkaline, will afford temporary protection from the inhibitory effects of acidity. Much tedious research is essential to find how nitrogen does become available to the tea bush, but there is obviously an elaborate natural mechanism to prevent its loss by leaching out of the soil.

Finally I urge the necessity for a vigorous programme of basic research work. Field experiments and practical trials both at St. Coombs and in other districts are undoubtedly of the first importance and the ultimate goal of the Tea Research Institute is acknowledged to be the provision of sound practical advice. The ultimate goal cannot however be achieved without a primary objective and this must be basic research into the fundamentals of the various branches of science which lead up to the practical findings. As this is my final lecture as Director of the Tea Research Institute of Ceylon, I do, most sincerely, urge the industry to ensure that basic research is never stinted, that generous facilities and experienced workers trained in research methods are always maintained at a strong and active central station, where the various research specialists work as a team.

Do not at any cost allow the Institute to disintegrate into a series of small units trying to give advice on localised problems without an adequate backing of sound fundamental knowledge.

FUTURE CONSIDERATIONS IN THE NUTRITION OF THE TEA BUSH

J. A. H. Tolhurst

Although the theme of this Conference is the future of the tea industry in Ceylon, I intend to begin by taking you back some thirty or forty years to apple orchards in the United Kingdom.

At that time, following the first war, there was much concern over a damaging leaf scorch in fruit trees, and this was soon diagnosed as potash deficiency, largely through work done at the research station at Long Ashton. The cure was easy, and as at the same time it was found that increased potash manuring improved wood growth and fruit quality, potash was used liberally, often to excess. Potash manures became more concentrated and the older low grade kainit, which had a goood content of magnesium, went out of favour. Too high potash manuring only aggravates the plant's problem of obtaining magnesium from soil which is already low in this latter nutrient.

In the 1940's, magnesium deficiency was recognised as a widespread problem in fruit orchards, and as it was not so easy to put right as potash deficiency in fruit trees, considerable research was devoted to it. That was my first experience of applied research when I joined Long Ashton and I had plenty of contact with magnesium problems by the time I left there and transferred my attention to the nutrition of the tea bush.

We come back to more familiar ground now, and I make no apology for the foregoing digression. Although it is hardly that, because the analogy seems to fit quite closely; potash deficiency in tea some years ago has been followed by higher manuring in general and often much higher potash manuring in particular. Yields have risen, carrying off more and more of all the nutrients essential to healthy growth, and the manures most favoured by the tea industry do not contain much magnesium.

Above all, the soil conditions in Ceylon are those which would be expected to produce magnesium deficiency. High rainfall, highly acid soils, and low or very low magnesium in the parent rocks from which these soils derive.

With all this in mind I was on the search for signs of the deficiency and in the last few months I have found several occurrences over a wide extent up-country. Many crop plants, of which tea seems to be one, often develop characteristic patterns on their leaves and shoots depending on which nutrient is lacking or, sometimes, is in excess (SPECIMENS EXHIBITED). Making due allowance for other factors which can discolour or distort the foliage, the diagnosis of nutritional disorders by visual symptoms can be very useful. But they are not infallible, and they must be taken as evidence that the plant is now fighting a losing battle.

One interesting point in regard to magnesium symptoms is that they seem to be masked to a large extent by nitrogenous manuring. This is well known in magnesium deficiency, but do not let it mislead you in to thinking that the trouble can be cured by high nitrogen, because there will come a stage when the magnesium deficiency is so severe that the symptoms can not be masked by anything except magnesium.

A further point to note, especially in view of the present emphasis on clonal material, is that different clones of some plants make different demands on nutrients. I have now seen three separate clonal plots where this is very evident in tea, some clones being well marked with the magnesium symptoms, others less distinctly and others with no symptoms at all.

Let me assure you that magnesium deficiency in tea is not merely an exercise in scientific research. It has been a serious economic problem in many crops in many parts of the world, and the effects can sometimes be disastrous. The first record of the deficiency in tea was made in a field where patches were getting weaker every year. The exhibits shown were taken from a field, on another estate, a few acres of which had been put out of cultivation because the yield fell to an uneconomic level after years of steady decline.

Let me also assure you that my references to the antagonism between potash and magnesium do not constitute an argument against high potash manuring. What they do suggest is that if potash is to be increased, for one reason or another, then the already existing necessity to consider magnesium as a normal constituent of manurial mixtures, as of course it should be, will be brought home more sharply. It would have been a pity if tea had gone the way of some crops, out of potash deficiency into magnesium deficiency. There is now no need for that to happen.

We are beginning trials with magnesium sulphate and dolomite as commercial manures for magnesium, and at the moment we favour dolomite, which is obtained locally, is cheap and is not too soluble. It also contains a high proportion of calcium, which is just as essential to the nutrition of plants as magnesium and which is nearly as often overlooked in the growing of tea. I find it rather interesting that the tea bush contains so much calcium when the soil it grows on is so acid. I cannot believe that the calcium goes into the bush just by chance.

Saphosphosphate too is high in calcium and it may be that much of its value is due to that fact. It may be that more attention to the calcium status of the soil would prove of value, especially where the actual availability of other nutrients to the roots of the tea bush is concerned.

This is as yet, conjecture and is related to the interesting subject of soil pH with the well known danger of exceeding a certain pH value.

It may therefore be of interest if I mention a deficiency of manganese which I found on a few bushes growing near bonfire sites where the soil pH had risen to between 6 and 7. Manganese is yet another essential nutrient, but whereas magnesium and calcium should be considered with the major nutrients, manganese is definitely a trace element. I do not want to say too much about manganese deficiency because I do not want you to assume that high pH invariably causes such a deficiency. It will only do so if the soil is low in manganese to begin with, and this particular soil was of that nature. It may be worth bearing in mind that if one area of soil has been found low in manganese there may be others as low or lower.

I will not describe the symptoms of manganese deficiency and I can not show you any specimens because I cured them in the process of diagnosis. But I will digress again in describing the diagnostic technique I used for this and for magnesium deficiency.

It is now standard commercial practice in several of the major crop systems of the world to spray the foliage with nutrient solutions where the necessity arises. This is usually done in conjunction with pathological sprays, for reasons of expense, and usually with trace elements, for reasons of plant physiology.

To generalise, many plants seem to absorb most nutrients if suitable solutions are sprayed on to their leaves under suitable conditions. There are snags, but where the method works it gives a quick and definite response to a known nutrient. The two deficiencies I mentioned responded very rapidly to selected sprays, chosen so that I was able to decide without doubt which nutrient had cured the symptom, and restored more vigorous growth.

I am not, under any circumstances, recommending the commercial use of foliar nutrients on tea at this stage of our knowledge. I will offer advice as far as I can, but the responsibility will rest with the user.

Another reason for not stressing manganese deficiency is that, with the one exception, our analyses have shown an amazingly high content of this trace element in the old leaf. Whether or not this is desirable we have yet to learn, and I have made a start on this problem.

The last visual symptom which I wish to discuss (SPECIMENS EXHIBITED) has a very widespread occurrence, but so far the cause remains a mystery. From my own observations and from specimens sent in it would seem that the yellow or orange chlorosis with a network of green veins in contrast is very common at lower elevations and in the drier districts. It seems to be connected with sun scorch quite often, and it has been reported to occur in conjunction with shot-hole borer. Such correlations need very careful substantiation, and even if we succeed in establishing one we have still to decide which trouble came first.

Until I can get detailed chemical analysis I can not do more than guess at the cause of the chlorosis, even to whether it is nutritional or not. From the appearance I would suspect that one or more trace elements are out of balance, and if so, then the relation to certain climatic conditions becomes more feasible. It would then be connected with my earlier remarks on calcium and the availability of soil nutrients. Any work on these lines would in turn be connected with the effects of soil pH on nutrient uptake and, in view of the importance of magnesium, we should consider the possibility of using magnesium instead of some of the calcium, to kill two birds with one stone.

The reason I introduce this 'thinking aloud' is to suggest to you that the seemingly disjointed subjects, which I have only been able to sketch in, may be more closely connected after all, and the solution of a problem which at the moment looks like a rather pretty pattern on the leaf may lead us to considerations of far greater practical importance.

FUTURE PROSPECTS IN THE LOW COUNTRY

T. E. Walter

The spotlight has already been turned on the low-country at this Conference in connection with the call for more and still more tea; I therefore propose in this address to focus it on some of the agricultural problems which will have to be faced in meeting this call.

As Mr. Portsmouth has already told you there are 3 alternative methods of expansion of the tea industry,—namely, by raising existing yield levels, the replanting of worn-out uneconomic areas, and new planting. Although most of this large scale expansion will probably be by new planting, I nevertheless want to start by drawing attention to the problem of the poor uneconomic areas—deferring the question of the raising of existing yield levels till I come to discuss bush management in connection with new plantings.

The first point that strikes one forcibly about these poor areas is that they have undoubtedly sunk far below the level of the worst up-country areas; in fact they have now got to the stage at which they are beyond redemption and are a constant drag on the estates concerned. These areas are typified by large numbers of vacancies and passengers and actual counts of these show that their combined total may be as high as 40 per cent. of the total stand. From this one might reasonably estimate that fully 90 per cent. of the yields from these areas are being obtained from 60 per cent. of the total stand; when one recalls that the very wide spacing common in the early days resulted in a potential stand of only about 2,000 to 3,000 bushes per acre, it seems remarkable that these fields still continue to give yields as high as 400-500 pounds per acre.

Although these areas are, as already stated, beyond redemption, there appears to be a widespread tendency not only to try and carry them as long as possible but also to increase their yield potential, and to this end money and energy are consumed, firstly by adding enormous quantities of extra manure and secondly by intensive supplying.

With regard to the first, experience has shown conclusively that this policy merely results in large amounts of money literally going down the drain, since neither the stand per acre nor the condition of the bushes justify the attempt to boost yields in this way. In other words, there is no simple formula—short of replanting—for the rejuvenation of these areas, and there is no time like the present for implementing a policy of ploughing back profits into a planned replanting programme.

With regard to the general question of supplying, results achieved in past years do not as a rule indicate that it can be regarded as a satisfactory alternative to replanting, and in fact records show that many of the poorest fields on some estates have been completely replanted several times over in the last few years by means of supplies. (*Note* 1).

Note 1.—This should not of course be taken to mean that large scale supplying is impossible! In fact, many low-country estates have enormous supplying programmes under way, and where adequate attention is paid to their after-treatment, the results so far achieved are encouraging. However the point is that supplying is undoubtedly not the best way of dealing with the poorest and oldest fields, and the necessity of periodical replanting has been stressed in nearly all the other papers, giving the viewpoint from various scientific angles. It is also relevant to tie in this question with the possibility of a subsidy for replanting, which was mooted elsewhere at the Conference.

Obviously therefore supplying on a large scale in old tea has its limitations, and for this and other reasons it would be logical to suggest that it is carefully integrated with a (long term) replanting programme; in fact, this means that the supplying of new clearings should always have first priority, while next on the list of priorities should come the more vigorous fields, with a long useful life in front of them. Ignoring this policy in the past has largely contributed towards the making of these poor areas and one can only hope that the vicious cycle will not be allowed to set in again.

Coming now to the main reasons for the decline in yield potential of very large areas of low-country tea; the first and most obvious reason is old age. It is not of course possible to state what the economic life of the tea bush is in the low-country, since it depends so much on local conditions and the system of bush management adopted; undoubtedly however, it is inherently much lower than up-country, a primary reason being the far greater liability to wood-rot.

Under the contributions towards this decline in yield potential made by systems of management, I would stress pruning as being a factor of prime importance and in particular the fact that too low pruning in the past has caused the partial destruction of what were previously well-developed sturdy frames. The problem of rebuilding these frames has been greatly complicated in many districts by the fact that the new wood which is put on is particularly liable to attack by shot-hole borer.

Another tendency, universal in the past and still apparent to-day is to leave insufficient leaves or rim lungs on the bushes at pruning time and this has probably resulted in more deaths than any other single cause; I shall, however, be returning briefly to this point later. Thus a combination of bad management and unfortunate circumstances in the past has either imposed an artificial life span of about 25 years on the bushes, or seriously reduced the yield potential of nearly all low-country tea. Nevertheless it is encouraging to be able to record that there are some 40 years old fields in the low-country which still yield over 1,500 pounds per acre.

Coming now to the main line along which expansion of the tea industry in the low-country will probably take place—namely, new planting. In planning large new planting programmes the first issue to be settled—and (for low-country planters) an extremely vexed one—is the type of planting material to be used.

Mr. Portsmouth has already stated the case for using high yielding vegetatively propagated material, and in applying his remarks to low-country conditions it is necessary to point out that a large part of the low-country tea acreage is situated in areas that might be described in the present context as 'marginal' from a climatic point of view. It would of course simplify matters if we could say that only the most suitable areas of the low-country should be developed, but unfortunately estates have a way of being situated in areas where conditions are far from ideal. For immediate plantings in such areas therefore the fact that seed at stake is often easier to establish in the early stages than the V.P. selections currently available will naturally have to be taken into consideration when really large acreages are to be planted up. However, the use of V.P. plants on a limited scale is of course perfectly feasible in all low-country areas, and the selection of drought resistant clones has in fact reached an advanced stage. Thus, on our V.P. new clearing at Vogan this year, several of the clones which were received for trial from Opata Estate (in the dry zone) attained 100 per cent. success, while the overall success achieved was about 70 per cent.

With regard to the yields which some of the more outstanding low-country clones now under trial are giving, (*Note* 2), the figures shown in the following table may be of interest:—

Note 2.—To forestall enquiries for clonal material from our clonal trials area, I would point out that, as all our promising clones are being tested for yields (amongst other things), it will not be possible for us to supply cuttings from these clones. Those interested in obtaining any of these clones are therefore advised to get in touch with the superintendents of the estates concerned.

Table 1—1951 *series clonal trials*
(*Old rubber land—Vogan Estate*)

Clone No.	No. of bushes	Calculated yield lbs. per acre	Blister blight incidence
36	27	1610	Nil
220	58	1691	Severe
215	151	2340	Severe
123	111	2737	Severe
106	130	2898	Nil

These figures show the yields, calculated for a stand of 5,000 bushes per acre and 23 per cent. outturn, for the first year of plucking, for a number of clones from Sirikandura Estate, based on the results of the first 8 months (April-December, 1954) during which the bushes have actually been in plucking. In fact the latest indications are that the actual yields for the first 12 months of plucking will probably be considerably in excess of the figures given, and clone No. 106, for example, is likely to exceed 3,000 pounds per acre. These 5 clones represent the final pick from over 700 original selections on Sirikandura Estate, where selection work was started in 1938. They have all been tested for quality, in which respect the 3 highest yielding clones are outstanding; the rooting percentage of Nos. 123 and 215 is, however, rather on the low side. It will be seen that I have included an assessment of blister blight incidence, as it is becoming fairly obvious that low-country planters will have to contend with blister blight on an ever increasing scale, at least during the N.E. monsoon. The selection of blister blight resistant clones will, therefore, be of increasing significance, although for the time being in most areas lopping of shade trees before the N.E. monsoon should provide some degree of protection against loss of crop.

I would add that about 30 more of the best low-country clones in our collection are now being brought into bearing on our Vogan plots, and many of these appear to be comparable to the ones shown, which were in fact one year older than the rest.

The figures given in the foregoing table are not, however, by any means unique in the low-country, and another estate (Niriella) reports that, as a result of a year's test plucking of 10 bushes of various clones, four were found to give calculated yields of over 3,000 pounds per acre, and another 2,500 pounds. Some allowance has of course to be made when only small numbers of bushes are test plucked. In assessing the value of such figures, therefore, one always comes up against two questions,—firstly what yields might be expected on an estate scale, and secondly, what yields might be expected if the clone is planted on your 'Bungalow field', where in spite of the extra supervision it gets the soil is well known to be about the worst in Ceylon! I am therefore glad to be able to provide some figures obtained from Sirikandura Estate which answer both of these questions, and which are of special interest in view of the doubts expressed at this Conference as to whether such poor areas are really worth while replanting in tea at all.

Table 2.—*Sirikandura Block A. Clones* 39, 106 *&* 123.
Planted 1947 @ $3' \times 3\frac{1}{2}'$.

Cycle	No. of bushes	Yield lbs. per acre	
		1st year	2nd year
(1) 1950/52	500	860	1495
(2) 1952/54	615	2105	2260

For the purpose of this experiment, carried out by Mr. Cecil Dias, a few of the poorest patches in a field, which has never given more than 600 pounds per acre, were pulled up and replanted with various selected clones in blocks, without any soil improvement measures; the resultant yields to date for the first of these blocks to be replanted are shown in Table 2. Note firstly the wide spacing ($3' \times 3\frac{1}{2}'$) used for this planting, giving a stand of only 4,150 bushes per acre, which was used for the calculation of these yields. I would take this opportunity of stressing that close contour planting is still the order of the day, for although wide spacing can result in a complete cover of tea if outstanding V.P. material is used, the potential yields are bound to be limited owing to the total area of the higher yielding central portions of each bush being relatively less. In other words, a stand of between 5,000 and 6,000 bushes per acre should always be aimed at, for which purpose 2 feet between the bushes and 3-5 feet between the lines (depending on the lie of the land) is suitable.

A further point in connection with Table 2 is that separate records of clone No. S.39 show that its yield is only 25 per cent. of the other two. As the three clones were planted in approximately equal proportions, the effect of the inclusion of this clone has been to reduce the yield that could have been obtained from this block by about 25 per cent.

In selecting V.P. material, the number of bushes that turn out to be outstanding is very small—possibly only about 1 per cent. of the original field selection. This means that a continuous and intensive programme of selection must be carried out if the best possible results are to be achieved. In this connection the comparative yields given by seedlings and by a very mixed bag of over 70 clones still under preliminary selection on Ederapolla speak for themselves. (Table 3).

Table 3—*Ederapolla experimental new plantings.*

Planted	Acres	Material	Yield lbs. per acre			
			1952	1953	1954	Total
1948	$2\frac{1}{2}$	Mixed clones	784	1050	304 (P)*	2138
,,	30	Seedlings	518	949	239 (P)	1706

*(P) = Pruned

This shows that, in the first cycle of bearing, an increase of 25 per cent. in yield was obtained from the V.P. area as compared with the seedlings; obviously, therefore, money spent on preliminary field trials on an estate scale will not be wasted, provided of course that the initial selection is properly carried out.

Another question which concerns low-country planters is whether outstanding up-country clones can be expected to be equally outstanding in the low-country; many low-country estates are now experimenting with up-country clones, the usual tendency being to try and save a year by transferring well grown plants. This practice has already been condemned in principle by Mr. Loos in connection with the danger of transferring eelworms in the soil, and I would further condemn it in the present context on the ground that the plants cannot be expected to adapt themselves readily to such a sudden change of climate. This supposition is supported by the fact that in nearly every case where clones have been transplanted from up-country nurseries they have proved an almost complete failure; usually, in spite of every possible care and attention they tend to do nothing more than just stay alive and go to seed.

On the other hand where cuttings of really outstanding clones have been transferred (as recommended) and grown in low-country nurseries, the resulting progeny have, as a result of this acclimatisation, often shown themselves well suited to large scale planting in the low-country. Amongst the T.R.I. clones which have been tried at low elevations, I would particularly mention Nos. 25, 2023, 2024 and 2026 as being outstanding—at least in the Ratnapura and K.V. districts.

The success which can be achieved in the low-country with selected V.P's is very largely dependent on the plants receiving the correct treatment from the nursery stage onwards. Running quickly through these stages, the first point that should receive more attention is that V.P. cuttings should only be put in during spells of rainy weather.

Mr. Portsmouth has already given details of the type of shade we recommend for nurseries, and the accompanying photograph (Photograph No. 1) shows the very fine results that can be achieved in the low-country with $\frac{1}{4}$ inch open weave coir matting. Comparative tests have been made with several clones under this coir matting and under fern, and the coir matting invariably produces not only a much higher percentage of success, but much quicker and more regular growth.

It may be of interest to note here that this coir matting has now been in use at Vogan for over a year and shows no sign of any deterioration; it is also a remarkable fact that the Vogan labour force has not as yet found a suitable use for it! Nevertheless, many planters may be apprehensive on this score, and accordingly, as a less effective alternative to coir matting, I would advise using an overhead pandal of bracken fern in preference to the usual method in which the fern is put in the ground.

Regarding field planting, it is of the utmost importance that only well-grown plants are used,—preferably either grown in baskets or transplanted to baskets in the nursery some months beforehand. The optimum stage is usually reached after about a year in the nursery,—the exact time varying considerably not only in different districts but also with different clones and with the type of shade used.

I would also take this opportunity to stress the importance of establishing early a good cover of bush green manures to act as protection from the sun and wind,—also of cover such as Stylosanthes to reduce excessive leaching and run-off of surface moisture. With the same end in view Guatemala grass is also a most effective material for thatching new clearings and can be expected to last 4-5 months under low-country conditions.

So much for some of the agricultural problems in connection with new planting: needless to say, however, money spent on attempts to improve existing yields and on expansion by new planting will be to a large extent wasted if adequate attention is not paid to subsequent bush management—in particular the factors which lengthen the economic life of the new plantings and arrest the rate of debilitation of the old ones.

Amongst the former, I would draw attention to the fact that many low-country estates are still centering new clearings into wood $\frac{1}{2}$ inch or more in diameter, which, even if callussing is complete, is bound to result in the gradual development of wood rot low down in the frames. Methods such as 'layering' and 'bending over' (*Note* 3), which do not involve the use of the knife, are particularly applicable where vigorous growing clones are used, and many V.P. new clearings are in fact being brought into bearing by these methods in 18 months and even less.

Note 3.– See *Tea Quarterly* of June, 1953 (Conference Number), Vol. XXIV parts I and II, pp. 39-42.

A nursery bed of well grown V. P. plants about a year old (recently centred), showing the coir matting shade rolled back. This material is made in strips 2 feet wide, joined together to form strips 4 feet or 6 feet wide; in the photograph it will be seen that a strip 4 feet wide was used (the nursery bed being 3 feet wide), and if this is done it is essential to put bracken fern or similar shading material along the sides.

Note the iron framework which is the most suitable means of supporting the coir matting.

Pruning is a process which is liable to include a multitude of sins, amongst which the serious epidemic of clean pruning noticed recently deserves special mention. The question of pruning at low elevations is intimately bound up with starch deficiency, and the experiments concerning these related problems were fully summarised by me in the current number of the '*Tea Quarterly*', (*Note* 4). In drawing your attention to the necessity of leaving rim-lungs, at elevations below about 1,500 feet, I would emphasise that a few whippy branches left round the perimeter 'below the level' do not constitute adequate rim-lungs. In fact, these should be of sufficient number—or in the case of a cut-across the prune should be sufficiently light—to ensure that at least 250 leaves are left on the bushes at pruning time. If this is not done large numbers of the weaker bushes will probably either die or make only a partial recovery from pruning.

Slope pruning is also a matter which merits far greater application in the low-country, though I must add here a word of warning—namely, that the cut on the lower side of the bushes should not be lower than 18 inches, and the total slope not greater than, say, 3 inches at the first prune. A further difference of 3 inches can be achieved at tipping, giving a maximum initial plucking slope of 6 inches.

In conclusion I have a few words to say regarding pruning cycles, which are of particular importance in the present context, both from the angle of obtaining the maximum yields, and in connection with pests and diseases. This subject came up for investigation about 2½ years ago, when we were informed that it was impossible to run a 3 year pruning cycle in the low-country, owing to the limitation imposed by a leaf disease which is universal in the low-country towards the end of the second year of the cycle onwards. This leaf disease—attribued at the time to Rhizoctonia—is characterised by large numbers of the lower leaves turning brown and either falling off or being held in the bushes by masses of horse hair blight. Accordingly an experiment with various pruning cycle lengths was laid down at Ingiriya, in an area where the leaf disease in question was known to be particularly prevalent.

Leaving the question of this leaf disease for a moment and switching to die-back in relation to pruning cycles; about a year ago I started making investigations into the time during the cycle at which die-back, accompanied by loss of crop, reached its height. These tended to show that in the worst areas the loss of crop in old tea reached really sensational proportions between about the 18th and the 24th month from pruning, the exact time varying in different localities. In new clearings, especially those in the first cycle of bearing, this stage is reached considerably earlier—in many cases at 15 months from pruning, or even less.

The condition referred to was characterised by an enormous amount of die-back on every single bush, and consequent sun scorch was so prevalent that in many cases the superintendents were inclined to suspect serious potash deficiency (symptoms of which are rather similar). Die-back and loss of crop were so great that it was obvious that there were only two alternatives—either to prune the fields more or less straight away, or to rest them for an indefinite period, since there was virtually no flush coming on at all. These observations, coupled with various further enquiries, tended to show that there was a strong case to be made out in favour of an 18-20 month cycle in these districts, with the object of pruning the tea before the worst effects of the die-back became apparent.

I will come back to this point shortly, and now wish to revert to the question of the leaf disease mentioned previously, on which observations were proceeding concurrently. The next development on this subject was that a field was found, which by chance had been allowed to run on beyond the normal two year cycle,

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Note 4.—See *Tea Quarterly* of December, 1954, Vol. XXV, Part IV, pp. 96-99.

on an estate, also near Ingiriya, where this leaf disease has always been extremely severe. Examination of yield records—continued since and shown here in the form of a graph (Figure 1), showed that there was no appreciable decline in yields during the south west monsoon of the 2nd year in the cycle, when the leaf disease was at its height. By way of comparison the yields from this field of old tea are shown together with those of a 1948 new clearing on an adjacent estate which has now run 34 months, from which it will be seen that young tea is—under these conditions—a still better candidate for a three year cycle. It is important to realise, however, that neither field showed any sign of die-back.

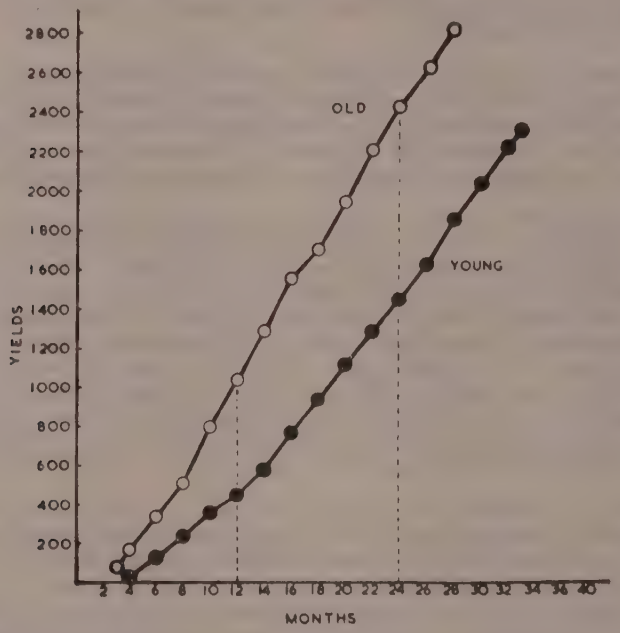

Fig. 1

This put the Ingiriya investigation into an entirely different light and in fact it was now obvious that the leaf disease referred to on our plots had merely confused the issue, the principal if not the only cause of the current fall in yields being the die-back previously referred to, which is unrelated to leaf disease, but which can be so serious that every single branch of some bushes is affected. Bearing this in mind, it is now of interest to examine the information contained in the Ingiriya experiment to date which is shown here in the form of a diagram (Figure 2).

The main points in connection with this are the following:—

In the case of the 18 months cycle, although the plots were out of plucking for 4½ months following pruning (into the dry weather), subsequent yields rose extremely rapidly; in fact by the end of two years the leeway lost had been almost completely made good, and there was only a difference of 120 pounds in yield between this and the other plots; at this stage (*i.e.* 2 years) the 2 year cycle plots were pruned, and subsequent yield trends of the 2½ and 3 year plots show a marked falling off, following the appearance of severe die-back. The rapid rate of increase of the 18 month cycle plots (previously noted) is, however, maintained, and in another 10 weeks the three plots are equal.

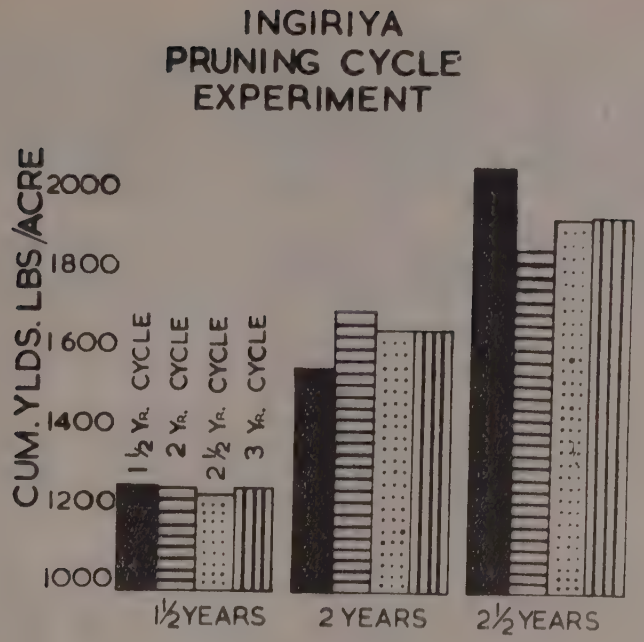

Fig. 2

By the end of 2½ years, (*i.e.* December, 1954) we find the 18 month cycle plots 130 pounds ahead, and the gap is actually continuing to widen.

A direct comparison between any two different cycle lengths can of course only be made when their times of pruning coincide; moreover in an experiment of this nature, results achieved in the first three years naturally have to be treated with some reserve. On the other hand a final assessment cannot be made for 15 years, at which time the pruning of all the plots will again coincide.

Regarding the treatment of these plots, it should be recorded here firstly that all plots were initially pruned at 18 inches (needless to say leaving rim-lungs) and secondly that they have been manured twice a year at 1½ times the normal level; the possibility that artificial limitations may have been imposed on the yield levels—particularly of the plots running into the third year—may therefore be discounted.

It is not possible at this stage to state the exact cause of the die-back referred to (which made its appearance in all the plots—except of course the 18 month cycle ones—during the south west monsoon of the 2nd year in the cycle). However, in my opinion it is very closely associated with shot-hole borer, which occurs in the all areas where the die-back under review is prevalent; moreover, of the innumerable bushes examined I have never yet succeeded in finding a single one which had die-back but not shot-hole borer galleries. This observation may be highly significant, especially in view of the fact that shot-hole borer galleries impose an artificial drought on the bushes by interruption of the water supply—the effect of which would naturally be accentuated by insufficient shade. However, a direct correlation between shot-hole borer and die-back is a matter which I personally would not attempt to prove, and at this stage I shall have the greatest pleasure in handing over this particular problem to Dr. Baptist.

I would summarise these findings as follows:—

(i) In areas which suffer from severe die-back (during the 2nd or 3rd year of the cycle) it is obviously impossible to extend the cycle to 3 years (as recommended in other districts as a means of reducing shot-hole borer incidence) without very serious loss of crop. I would, therefore, suggest that where die-back associated with shot-hole borer occurs, the results to date indicate that an 18 month cycle be very seriously considered, though any firm recommendation to this effect must naturally depend on information gained during the future course of the experiment.

(ii) In areas where the die-back under review does not occur, experience has shown that it is perfectly possible to run cycles of 30 or even 36 months without appreciable loss of crop, provided that the bushes are high yielding and remain in a vigorous condition.

PRACTICAL ASPECTS OF REPLANTING

E. S. Rose

In the past few years many companies have considered opening up new clearings, with particular reference to uprooting old and uneconomic tea. Various methods of uprooting tea have been tried with varying success on St. Coombs; most of these methods have been tested in an endeavour to prove that the replanting of old tea can be done at a reasonable cost. I propose to mention briefly these various methods.

Uprooting by hand has been tried by some estates. While this type of uprooting is possible, it is highly unsatisfactory in that labourers are prone to leave almost as many roots in the ground as they remove, thereby increasing the risk of root disease appearing subsequent to the replanting. In any event the cost of such uprooting is inclined to be rather high.

A small area of approximately 2 acres of old tea was removed with a Trewhella 'hand' grubber or 'monkey' grubber on St. Coombs. This machine was quite satisfactory in that it is capable of pulling out even very large tea, but the cost per acre was high. Four labourers working as a team were only capable of removing 22 bushes each per day. For small areas where the slope of the land is not too acute, this method can be recommended since the initial capital expenditure on equipment is small, but in thick tea on steep slopes, I think it unlikely that the machine could be satisfactorily operated without a severe reduction in task. For any large area, of more than 4 or 5 acres, the time taken to remove the tea would make this method far too slow.

The Trewhella 'mechanical' or 'horse' grubber was used on St. Coombs for some considerable time and in the early stages appeared to be a possible solution to the problem. This machine consists of a small but powerful motor driving by means of a belt a series of gears directly coupled to a small drum with cable attachment. It is heavy and extremely immobile. Uprooting tea in light friable soil, the machine was capable of removing up to 300 bushes per day, providing the lie of the land was not too steep, but in a heavier soil and on steep land the moving parts tended to wear very rapidly and the cost of repairs became exorbitant. Rs. 127/- per acre over 12 acres was the actual cost for repairs alone. While this machine was an improvement it was not as good as expected.

A power winch seemed to offer better possibilities. There are two power winches, which would appear to be satisfactory for uprooting tea on a large scale, and both require a tractor for the power-take-off. The Fordson 'Major' tractor and Boughton winch has been used with success on an estate in the Dimbula District on the most difficult of terrain, but there is one slight disadvantage in that the winch itself is a semi-permanent fitting to the tractor and takes a considerable time to fit and remove, in the event of the tractor being required for any other work at short notice. At the present moment a Fordson 'Major' tractor with the Hesford Hercules winch is being operated on St. Coombs. The winch itself is of a trailer type and can be connected or disconnected in a matter of a few minutes, thereby making it possible for the tractor to quickly carry out other work, should the necessity arise. A further advantage is the fact that any medium sized tractor with a power-take-off can be used with this particular winch. The winch has 300 feet of $\frac{5}{8}$ inch diameter

wire rope attached to the drum and this is used in conjunction with a pulley and a ground anchor, thereby reducing the load. Small lengths of wire rope or chains, with a hook and shackle attached to each, are fastened round the bushes, which in turn are hooked on to the main length of wire rope. The machine is controlled by the tractor driver, in that the speed of the winch is regulated by the speed of the tractor engine. A safety clutch is fitted between the tractor and winch on the main power shaft, which can be pre-set to slip at a specified load. Approximately 10 labourers are capable of uprooting between 350 and 400 bushes per 6-hour day. On one occasion as many as 475 bushes were removed. The advantage of uprooting tea by this method is that fewer large roots are left in the ground, thereby eliminating to some extent the possibility of root diseases appearing in the new clearing.

I now propose to run through the various works required to complete the clearing up to the time of the tea coming into bearing. In most cases after old tea has been removed, new drains will have to be cut, in conjunction with the lining up on the contour in preparation for the formation of the final terrace. It has been found in practice that intervals of 4-5 feet measured horizontally between the rows give the best results. The use of a standard length rod and plumb line does away with the necessity of differences between contours as measured along the slope arising through variations in slope. It is not always possible to maintain perfect contour lining, but small compromises will have to be made to eliminate as far as possible short rows.

Trenches should now be cut on the contour line 18 inches deep by a foot wide and Guatemala grass cuttings planted along the top side of the trench in preparation for soil rejuvenation. After a few months, when the Guatemala grass has produced some maintenance foliage, it is recommended that a suitable manure mixture be applied above the Guatemala grass and dibbled in with small weeding scrapers.

When the grass is well established and has reached a height of 8 to 10 feet it should be lopped not lower than 9 or 10 inches from the ground and the loppings put in to the trenches. It is possible that a certain amount of wash will have occurred before the Guatemala grass becomes established and the trenches may therefore have to be cleaned out immediately prior to the first lopping of Guatemala grass. The grass should then be lopped at intervals of a few months depending upon the growth, and manured each time, approximately 3 weeks after lopping.

It is recommended that the cleared area should remain under Guatemala grass or some similar bush green manure for 2 years and certainly not less than 18 months. At the end of this time the grass should be cut across at a little below ground level with a sharpened mamoty, incorporating as much of the cut material into the trenches as possible. The trenches should then be filled and levelled to form a series of small terraces, any balance green material being used as a thatch. Along the edge of the contour where the Guatemala grass originally grew, *Tephrosia vogelii* or some similar green manure should then be planted with a view to forming a windbreak and shade, in preparation for the young tea plants, the idea being to reproduce, as nearly as possible, conditions similar to the nursery conditions under which the plants have been growing in the few months prior to planting. It must be clearly understood, however, that this green manure must not be allowed to grow so large as to interfere in any way with the growth of the young tea plants, and it will therefore be necessary for this bush green manure to be uprooted and replaced from time to time, until the tea plants have developed to such an extent that they are capable of preventing wash and have provided sufficient ground cover by their natural spread.

It is recommended that a suitable artificial fertiliser mixture be applied to the *Tephrosia vogelii* to encourage its growth. This may be given as soon as plants have reached a height of 3 or 4 inches and should be dibbled in along the top side of the row with a small weeding scraper. At the time of planting the green manure

shade trees can be planted in the contour rows to enable them to become well established with a view to affording some shade by the time the tea plants come into bearing.

With the start of the rainy season the *Tephrosia vogelii* or the green manure, should be sufficiently tall to give the necessary protection for the planting of tea. The spacing we have found suitable for the young tea plants is 2 feet apart in the centre of the small terrace in the actual trench into which Guatemala grass had been lopped. The drain edge on the top side and all road banks should finally be supplied with any available tea plants, planted as closely as possible, ultimately to form a hedge to prevent soil erosion.

Young tea plants once established, should be manured every 3 months at approximately 1 ounce per bush of T/175 mixture. These applications to continue for 18 months to 2 years, gradually increasing the application rate until the plants are capable of taking up the normal T/488 mixture, which in the case of a vigorous clonal plant might even be less than 18 months.

The small plants should be tipped 3 to 4 times a year, with a view to encouraging growth from low down on the central stem, this to continue for approximately 2 years or until the bush can safely be brought into bearing. Normal field works such as draining, supplying vacancies, weeding, blister blight control and trimming of green manure and shade trees should continue.

I now propose to give a brief summary of the costs per acre based on labourers' gross wages at Rs. 2/30 per day. All costs are calculated on the ground being fallow under Guatemala grass for 2 years, with a further 2 years from planting of the tea to coming into bearing. Most of the costs are taken from actual new clearing work on St. Coombs, while other figures are based on estimates, but in any event they refer to a rather steep lie of land containing considerable rock. They therefore represent a possible maximum and do not mean that new clearings must inevitably entail an outlay as high as these figures seem to indicate. The expenditure incurred in uprooting tea based on a figure of 5,000 bushes to the acre proves conclusively that a power winch is by far the cheapest method.

Uprooting costs with the Trewhella 'mechanical' grubber on difficult terrain amounted to Rs. 1,339/97 against an estimated figure of Rs. 735/50 per acre using the Trewhella 'hand' grubber or 'monkey' grubber, while the power winch costs are Rs. 463/50 per acre. The estimated cost therefore of replanting uneconomic tea using the easiest and cheapest method of uprooting, works out at Rs. 5,250/00 per acre.

Detailed costs of all work necessary for the opening of a new clearing are shown in appendix A, and appendix B gives the various manurial mixtures recommended.

APPENDIX A

1. Cost of clearing land of tea with a power winch

(Based on Rs. 2/30 per day per labourer)

	Rs. cts.	
Labour at 10 per day at 11½ days per acre = 115 labourers @ Rs. 2/30	264.50	per acre
Driver's pay at Rs. 6/- per day	69.00	,, ,,
Kangany's pay	30.00	,, ,,
Oil, petrol and kerosene and general maintenance	30.00	,, ,,
Uprooting missed tea	80.00	,, ,,
Rs.	473.50	per acre

2. Cost of clearing land of tea with a 'hand' grubber:—

	Rs. cts.
Labour at 4 per day and 1 kangany, uproot 88 bushes per day. At 5,000 bushes per acre = 57 days per acre = 285 labourers. @ Rs. 2/30 per day	655.50 per acre
Uprooting missed tea	80.00 ,, ,,
Rs.	735.50 per acre

3. Cost of clearing land of tea with a Trewhella 'mechanical' winch

	Rs. cts.
Labour at 6 per day and 1 kangany, taken on actual cost over 12 acres = 464 labourers per acre at Rs. 2/30 ...	1,067.20 per acre
Petrol at 18½ gallons per acre	48.20 ,, ,,
Oil	17.62 ,, ,,
Repairs	126.95 ,, ,,
Uprooting missed tea	80.00 ,, ,,
Rs.	1,339.97 per acre

1A. Cost of clearing land of tea with a power winch & replanting (4 years)

		Rs. cts.
Clearing land of tea with a power winch ...		473.50 per acre
Cutting new drains — 60′ per labourer cutting reversed slope drains—20 labourers per acre @ Rs. 2/30		46.00 ,, ,,
Lining on contour — Cutting pegs — 3 labourers @ Rs. 2/30	6.90	
Pegging on contour—3 labourers ...	6.90	
Transport to field	.50	14.30 ,, ,,
Cutting trenches — 1 feet wide by 1½ feet deep, 120 feet per labourer per day		350.00 ,, ,,
Planting Guatemala grass — Planting Guatemala grass cuttings on the contour—6,000 cuttings @ -/05 cts.	300.00	
7 labourers @ Rs. 2/30	16.10	316.10 ,, ,,
Lopping Guatemala grass — 10 labourers and 1 kangany per acre, twice a year for 2 years— 44 labourers per acre @ Rs. 2/30 ...	101.20	
Clearing trenches prior to first lopping of Guatemala—44 labourers & 2 kanganies @ Rs. 2/30	105.80	207.00 ,, ,,
Manuring Guatemala grass — 4 applications at 2 cwts. per acre over 2 years @ Rs. 343/- per ton	136.00	
Application @ 5 labourers per acre ...	46.00	182.00 ,, ,,
Weeding — Monthly weeding @ 5 labourers per acre for 4 years, *i.e.* to the time of the tea coming into bearing 48 rounds = 240 labourers @ Rs. 2/30		552.00 ,, ,,

Cutting Guatemala grass at ground level and levelling on contour

		Rs. cts.
This item is almost impossible to estimate, due to differences in terrain, etc., but on a fairly steep area with above average rock outcrops, where stone terracing may be necessary in places, an approximate figure of Rs. 360/- may be required		360.00 per acre

Planting bush green manures and uprooting over 2 years

Planting *Tephrosia vogelii* at 20 lbs. per acre plus labour at 8 per acre, small application of manure mixture @ Rs. 300/- per ton, application rate of 16 oz. to 10 yds. of *Tehprosia vogelii* row—approximately 300 lbs. per acre. Application at 4 labourers per acre over 2 years, replacing *Tephrosia vogelii* twice in that period, gives the following costs, including uprooting old *Tephrosia vogelii*:—

Cost of seed	50.00	
16 labourers @ Rs. 2/30 for planting ...	36.80	
Cost of manure	80.00	
8 labourers @ Rs. 2/30 applying manure ...	18.40	
26 labourers @ Rs. 2/30 uprooting old *vogelii*	59.80	245.00 „ „

Lopping bush green manures—Lopping *vogelii* 3 times per year for 2 years @ 6 labourers per acre —36 labourers @ Rs. 2/30 ... ... 81.80 „ „

Shade trees — To hole and supply grevilleas, *Albizzia sumatrana* and dadaps as follows:—

Grevillea @ 18 per acre @ -/80 cts. ...	14.40	
Albizzia sumatrana 27 per acre @ -/80 cts. ...	21.60	
Dadaps 111 per acre	2.00	
2 labourers to hole and supply above ...	4.60	
Protection baskets	4.00	
Resupply vacancies	12.00	
Trimming	4.60	63.20 „ „

Holing & supplying tea — 4,200 plants per acre @ -/20 cts. will be required, planting 5′ rows by 2′ between plants 840.00

Protection baskets for same @ -/10 cts. per basket	420.00	
Holing @ 200 holes per man=21 labourers and 1 kangany	47.60	
Supplying @ 100 plants per labourer ...	92.90	
Transport charges	2.00	
Hand watering plants, in the event of drought @ 3 labourers per acre per round for approximately 10 days	69.00	1,471.50 „ „

Supplying tea hedges—To supply tea hedges on road banks and top side of drains ... ... 23.00 „ „

Manuring tea plants—Application every 3 months @ 1 oz. per bush of T/175 mixture=approximately 1 ton over 2 years 350.00

		Rs. cts.	
Application @ 8 labourers per acre per round for 2 years	147.20	497.20	per acre
Resupplying vacancies—To resupply approximately 20 per cent. loss		178.00	,, ,,
Tipping—To tip 3 times a year at an average of 3 labourers per acre per round=18 labourers per acre for 2 years @ Rs. 2/30 ...		41.40	,, ,,
Draining—To clean out drains once a year for 2 years @ 5 labourers per acre=10 labourers per acre @ Rs. 2/30		23.00	,, ,,
Spraying against blister blight—34 rounds per year for 2 years at 3 acres per round including transport and cost of fungicide, etc., approximately Rs. 1/80 per round=for 2 years ...		122.40	,, ,,
	Rs.	5,247.40	,, ,,

2A. Cost of clearing land of tea with a 'hand' grubber and replanting.

Rs. 5,247.40—473.50=Rs. 4,773.90+735.50 ... Rs. 5,509.40 ,, ,,

3A. Cost of clearing land of tea with a 'Trewhella' mechanical winch and replanting.

Rs. 5,247.40—473.50=Rs. 4,773.90+1,339.97 Rs. 6,113.87 ,, ,,

Presuming the land to be cleared is jungle and no soil rejuvenation is required, the following items would not appear:—

	Rs. cts.	
Cutting trenches ...	350.00	
Planting Guatemala grass ...	316.10	
Lopping Guatemala grass ...	207.00	
Manuring Guatemala grass ...	182.00	
Half weeding costs ...	276.00	
Cutting Guatemala grass at ground level ...	240.00	approximately
Rs.	1,571.10	

Therefore the total cost per acre, excluding clearing jungle, would be Rs. 4,773.90—1,571.10=Rs. 3,202.80

Expenditure on equipment

(To be depreciated each year)

Trewhella 'monkey' grubber

The Trewhella 'monkey' grubber 24 tons capacity complete with transport wheels, grubber and handle, snatch block, grab, 50 feet special drum rope and pull ropes 80 feet, 40 feet, and 15 feet anchor rope ... ... Rs. 1,250.00

Trewhella 'mechanical' or 'horse' grubber

The Trewhella 'mechanical' or 'horse' grubber complete with the necessary reduction gearing—belts & pulleys—3 h.p. benzine engine—70′ × 2½′ cirm. drum rope—60′, 40′ and 20′ × 3½′ cirm. pull ropes and 20 feet anchor rope ... Rs. 4,150.00

Hesford hercules 2-speed trailer winch

Hesford hercules 2-speed trailer winch on pneumatic tyres, with power-take-off, universal jointed shaft, rope guide rollers and sprag	£313–0–0		
1—300′ × ⅝′ diameter wire ropes	17–0–5		
1— 50′ × ⅝′ diameter rope with 6 rings	19–16–4		
6—6′ long ropes with 'D' shaped shackles fitted	26– 8–0		
2—Ground anchors and spikes ...	8– 0–0		
	£384– 4–9		
Plus 5 per cent. on the gross amount for packing and delivery charges to steamer	£ 19– 4–3		
	£403– 9–0		
Plus freight and insurance ...	20– 1–0		
	£423–10–0	*Rs.	5,645.25

(*Calculated at Rs. 13/33 to the £)

Fordson tractor		Rs.	9,913.60
Boughton winch	(approximately)	Rs.	5,500.00

APPENDIX B

1. Guatemala grass manure mixture:—

5 parts sulphate of ammonia
3 parts superphoshpate (20%)
2 parts muriate of potash (60%)
} To be applied at 2 cwt. per acre.

2. Tephrosia vogelii or green manure:—

4 lbs. sulphate of ammonia
6 lbs. saphos phosphate
6 lbs. muriate of potash (50%)
} To be applied at approximately 300 lbs. per acre.

3. Shade trees:—

As per plan ... Grevilleas at 18 to the acre.
Albizzia sumatrana at 27 to the acre
Dadaps or *Albizzia moluccana* at 111 to the acre

4. Manure mixture T/175 for young tea plants:—

100 lbs. sulphate of ammonia
50 lbs. saphos phosphate
25 lbs. muriate of potash (60%)

PRESERVATION OF QUALITY

E. L. Keegel

Quality, as the term is generally understood, is used to describe the characteristics that go to make up a tea, inclusive of its appearance. It is also used to denote the presence of one special characteristic, such as the quality of a high-grown tea. When used in this sense it serves to show the fundamental difference between teas produced at high elevations and those from the low-country. The so-called up-country quality cannot be reproduced at low elevations, and is an attribute that is difficult to describe, yet easily detected by a well trained palate. Since the word 'quality' may have either of these two meanings, there is bound to be some confusion as to which is really implied. The theme of my paper is preservation of quality in its general sense, but I shall also be referring to the special quality of high-grown teas, and when doing so, shall draw your attention to it.

Tea varies widely in quality, so much so that even districts and sub-districts of the tea growing areas in Ceylon produce different types. I might add that even neighbouring estates, following an indentical procedure in manufacture, are known to have turned out dissimilar teas. For a long time it was believed that the wide range in quality noted was primarily the influence of climate and soil. We now know that the over-riding factor is the bush itself. Even apparently similar bushes may produce vastly different teas. It cannot be denied that the characteristics of a tea are to some extent affected by the way in which it is made. But the point to remember is that no system of manufacture can produce any characteristic that is not already in the leaf. It is for this reason that some estates have not been successful in making a significant change in the character of their teas by modifications in manufacture.

That certain tea characteristics result from the inherent properties of the leaf is best illustrated by the following example. From an area of a particular field on St. Coombs Estate it was possible to produce a tea with practically all the features associated with a low-country tea. It had a well twisted black appearance, was coloury and strong and even had a dullish infusion. It was not any special method of manufacture that brought about these results, but the natural contribution from high jat leaf with its juicy sap. Countless examples from results of the manufacture of different bushes can be given to show the overwhelming effect of local variations of leaf on the finished product.

Quality has been synonymous with Ceylon tea. Climatic conditions and a special technique of manufacture have doubtless contributed in no small measure to the characteristic properties of Ceylon tea. However, it is quite evident that were it not also for the characteristic quality of the leaf in general, Ceylon tea would not have commanded the enviable position that it holds in the world markets today. The industry can, indeed, count itself fortunate that, largely due to a chance combination of jat and elevation, it can turn out teas of a very high potential market value.

The market value of a tea is mainly influenced by some distinctive and desirable characteristic. The black appearance of a low-country tea is a typical case and, really and truly, it is a good thing that most of the high jat tea is at the lower elevations, and China and hybrid jats up-country. Consider for a moment what the

position would be had it been the other way round. Our teas would have been entirely different and probably mediocre. We would have been turning out from the low-country, brownish leaf types with little colour. The high jat at the higher elevations would have produced less of the so-called high grown quality that we are familiar with, the essential feature of our up-country teas.

Over the last few years a marked improvement in the general standard of manufacture, assisted by improved standards of plucking, has enhanced the reputation of Ceylon tea. The general standard of teas has risen considerably and Ceylon has regained what was lost in the war years. It is now essential not only to continue maintaining this position but to build up a higher prestige for Ceylon tea. In recent years the acreage under tea in other countries has increased appreciably and it is not unlikely that in the near future new tea areas will be opened out in countries where one would least expect tea to be grown. The need for a higher standard of tea appears, therefore, to be all the greater as competition becomes stiffer in world markets. It is not too early to consider what steps should be taken to produce a better product.

The biggest stumbling block encountered in manufacture is the wide variation of the leaf on most estates. However uniform the jat on an estate may appear to be, the properties of the thousands of bushes that comprise it are unknown to the man who converts this raw material into tea. Is it any wonder then why it is so difficult to get the best out of one's leaf? The maximum development of inherent properties is only possible if these are known beforehand.

The logical thing to do in tea manufacture, therefore, is to take all possible precautions not to lose whatever desirable characteristics the tea as a whole possesses before it is plucked from the bush, and to try to develop those characteristics which teas from that particular area are noted for. It is pointless, for instance, rolling for 'tip' in an up-country factory or rolling for 'flavour' down in the low-country. The fundamental thing to observe is the preservation and development of those characteristics which will make a tea more valuable.

With specific reference to high grown teas, the problem is how not to ruin the distinctive and subtle quality they possess. It is quite impossible in the time at my disposal to deal with all the possible causes of loss of quality in the course of manufacture. I shall, however, refer to the more significant ones and these are withering at high temperatures, long withers, long periods of fermentation and long charging intervals. It will be noted that the four factors that I have mentioned are each conducive to the production of colour in a liquor. I have little doubt from my own observations, and results of experimental work, that colour is the very opposite of quality in a high grown tea. It is one thing to produce colour and quite another to produce colour and quality together. Colour in a liquor is always developed at the expense of quality. These two characteristics are so inter-related that a balance can be struck between them merely by an adjustment in the period of fermentation. In this way, it will be possible to alter the general characteristics of a tea to suit seasonal or market requirements. Much will depend on the fermenting properties of the leaf, but the shortest possible fermentation is recommended when quality is at a premium.

As fermentation is linked with rolling, I am obliged to make a reference to the latter. If quality is at a high level the standard of leaf appearance does not count for much. In fact, some of the best high grown quality teas would by normal standards be considered somewhat poor in appearance. Manufacture was not to blame; the leaf was responsible. Had this leaf been rolled for appearance quality would have been sacrificed. It does not follow, however, that good high grown quality leaf could be broken up in the rollers. The point I wish to make is that it is an utter waste of time in an up-country factory to try to get the black well twisted type of tea or to chase after an elusive tip. It is only worth doing if the nature of

the leaf is such that a good standard of appearance would compensate for poor quality. Whatever the circumstances, it is advisable to roll hard from the very first roll because, in the case of a high grown tea, what matters most is the preservation of its characteristic quality. Long rolling periods may prove detrimental to quality.

As a low-country tea sells primarily for its appearance, this quality should be developed to its maximum possible extent. Tip is also a valuable asset in a low-country tea and should, therefore, be removed in the early rolls. Lighter rolling and the use of large roll-breaker mesh are the obvious means of doing so. After the maximum amount of tip has been recovered rolling should proceed on lines directed to the development of colour, a characteristic which also governs the market value of a low-country tea. Long withers and long charging intervals would also help.

These are the broad principles. Minor changes to suit individual estates will be found necessary, but whatever is done the underlying idea should be to preserve the qualities the leaf possesses and develop them in an intelligent manner. In short, what is required in tea manufacture is a sense of proportion, with the full realisation all the time that 'tea is made in the field'.

In general, at whatever elevation tea is produced, it need hardly be stressed that the other fundamental requirements are:—

1. Undamaged leaf.
2. A good standard of plucking.
3. Adequate withering space.
4. Adequate equipment.
5. Proper organisation.

and 6. A clean factory.

Half the battle is won if closer attention is paid to these points.

In minimising the loss of inherent properties of the leaf in the factory by careful manufacture, a question that has to be considered by each and every individual estate is the rising cost of production. For little might be gained in producing a tea commanding a higher price if it is going to cost more to make it. Existing manufacturing conditions do not offer much scope for a reduction in costs, but by increasing yield the way is open to bigger profits. The potential yield of our tea fields at present is, however, limited, and there is a real danger that coarser plucking might be resorted to, influenced by misguided notions of economy. Coarser plucking is a retrograde step that must be avoided at all costs because it would only result in a poorer standard of tea. It would appear, therefore, that the only sensible approach to this problem is to have better planting material of much higher yielding capacity and of much better manufacturing properties. If this can be achieved, and there is no reason why it cannot be, not only will quality and yield be raised simultaneously, but the margin of profit increased as well.

Apart from the fact that selection of the right material would result in substantial improvement, there is another aspect worth considering. As distinct from an uniform standard of plucking from leaf of different characteristics, selection will provide uniform material, thus making the operations of withering and rolling for instance, far easier to control. Haphazard methods will give place to rational methods because the properties of the leaf handled are known, and in consequence a fuller control over manufacture can be achieved.

Our methods of manufacture still follow the patterns set up in the early days and, if we are to make the most of them, it is evident that we must have material of some degree of uniformity. Such material will not only help us to develop methods with greater accuracy, but also help us to get a better understanding of the changes and effects that take place in the course of manufacture.

One valid objection against uniformity of material is that a single clone may not have all the desirable characteristics. This may be true and it may be a painstaking job to discover one. But even so, one good clone with a high level of quality of a predetermined type would surely be worth more to an estate than the different and unknown kinds of bushes it is planted with.

From a blending view point a mixture of clones is a very good idea but it is not going to help us out of our real difficulty of bringing manufacture under better control. I wish I had the time to develop this point but it does not require much imagination on your part to realize the complications that different clones would introduce in manufacture. If blending is found to be necessary, the question, to which a ready answer cannot be given just now, is whether to blend before manufacture or to blend after manufacture.

The selection of clonal material for manufacture is a task that cannot be carried out in a shoddy and unbusinesslike manner. I have personal knowledge of some estates undertaking this work but not bringing it to a logical conclusion. I must add, however, in fairness to those concerned, that it was not due entirely to lack of interest but inability to carry out proper manufacturing tests. Some progress has certainly been made on a handful of estates but the fact of the matter is that vegetative propagation involves a very long time in rejecting and selecting. After propagation a further long period ensues before the clone has been proved beyond all doubt to be suitable. If profitable results are to be secured it would appear that there must be one single authority responsible for this type of work.

Should it prove feasible to replant with clonal material, areas that had been a liability in the past would become a valuable asset to the country. That is not all. The connection between quality and manufacture would be so clearly understood that teas could be improved to an extent unattainable at present. In the matter of quality and quantity there seems to be no limit.

The concept of the availability of improved raw material does not mean, however, that we must take quality for granted. However good it may be, one basic requirement is the efficient and intelligent use of machinery. For too long, the methods employed in tea manufacture have undergone but little change, and are so tied by custom that some of the ideas handed down from the past have now come to be regarded as standards. Blind acceptance of these methods narrows the outlook and would be detrimental to whatever material progress we may hope to achieve in the maintenance of quality.

Broadly speaking, as far as Ceylon tea is concerned, there should exist two main types of manufacture for the preservation of quality. One in which the liquor is the primary consideration, and the other where the appearance of the made tea is the more important feature; the development of either characteristic depending mainly on which is considered to be more valuable in governing the market value of a tea. It should be remembered of course that, in the quest for quality in liquor, appearance of the finished product must not be lost sight of. More often than not appearance of the made tea, by which I do not mean a black, well twisted tea, is a fair indication of its liquoring properties.

Finally, it is necessary for me to mention that, apart from the prospects of success by replanting, constant vigilance is required in maintaining a high standard of plucking. It would be detrimental to the industry's interests should this fall. Even handicapped by an ill-equipped factory, an estate harvesting good leaf need have no misgivings about the quality of its product. In fact, a good standard of leaf is the shortest route to the preservation of quality.

THE EXPANSION OF CLONAL PROVING

G. B. Portsmouth

Yesterday I pointed out that to ensure a reasonable return on the capital required for replanting or new planting of tea it was necessary to look for far higher yields per acre than are being generally obtained at present. It was also the considered opinion of the Institute that, in the immediate future, there was only one way of making reasonably sure of securing the high yields required—namely by planting up with selected high yielding vegetatively propagated clonal material.

Highy ields alone, however, are not enough and, as Mr. Keegel has just told you, the preservation and future improvement of our already high standards of quality are of equal importance if we are to maintain our position in the World's markets. It would seem, therefore, that the expansion of the Institute's work on vegetative propagation, with a view to making the necessary high yielding, high quality, approved clonal material readily available for new planting purposes throughout the Island's tea areas, was now a matter of some urgency. However, we have not been blind to our responsibilities and, as many of you already know, plans for a very large increase in the volume of our vegetative propagation work have already been passed by our Board and are in the process of being implemented.

Now, as I indicated yesterday, an increasing quantity of first class clonal planting material is becoming rapidly available at St. Coombs. However, owing to the extreme range of elevation and climatic conditions under which our tea is grown, planting material which is suitable for the up-country tea districts is not necessarily suitable for the low-country, or perhaps the different monsoonal conditions prevailing in Uva. In the past, with the exception of a certain amount of preliminary tests on Vogan Estate, Neboda, all our clonal proving trials have been concentrated at St. Coombs. As a consequence the majority of the better selections now available can only be recommended with complete confidence for planting under up-country conditions. It is true that very vigorous selections, such as 2024, will probably do well over a wide range of conditions. In fact, as I told you yesterday we already know that some of our better clones are doing outstandingly well under Uva conditions. Unfortunately the same degree of success has not been obtained so far in the low-country, where, as Mr. Walter has told you, only a small number of the up-country selections tried out have proved satisfactory. This limited geographical range of usefulness of any particular selection thus presents the main problem now to be overcome in making approved vegetatively propagated material more generally available.

The necessity for decentralising proving trials has accordingly been taken into account in drawing up plans for the expansion of our work on vegetative propagation. Two new clonal testing stations are to be established. One of these will be at our Passara Sub-Station, a site already approved by the Uva Planters' Association as representative of Uva conditions, while the other will be at a site, yet to be chosen, somewhere in the low-country. In this connection I would like to point out that any delay in the setting up of this new low-country clonal testing station will be entirely due to the almost complete lack of response to our request for offers of suitable land. In contrast, we very early on received an offer from the School of Agriculture, Peradeniya, to carry out voluntary testing for us, and we have already given two members of their staff the necessary training in methods and technique

at St. Coombs. Peradeniya should thus enable us to cater to some extent for mid-country requirements, while at the same time it will provide a useful half-way house for the direct comparison of up-country and low-country clones under more or less neutral conditions.

Starting from scratch and developing our own selections in these new districts is likely to be a somewhat slow process. However, there is already a large number of selected but unproved clones available on many estates. Accordingly, if these estates will co-operate in the scheme by making available to their local testing station cutting material from their better selections, it will materially shorten the time which must necessarily elapse before we are in a position to release approved clones suitable for a specified district. None of the new stations are as yet in a position to receive material for test, but as soon as they are we will circulate estates in the appropriate districts. In view of the urgency of the matter I earnestly hope that you will let us have an immediate response. In the meantime it will be of the greatest assistance if estates possessing a number of selected clones will do their best to classify them in order of merit.

The early release of approved first class clonal planting material, especially in the low-country, is of the greatest importance to the industry as a whole. However, if we are to achieve this objective in the shortest possible time, then it would appear to be essential that such estate selections as are finally approved as first class planting material must be made generally available in their particular district—a principle which has already been approved by both the Agency Section and the Standing Committee for Tea of the Planters' Association of Ceylon. This free release system will not operate to the detriment of estates responsible for the original selections, since, if they have continued their own propagation work, they should be in the happy position of having a much larger quantity of approved planting material available than anyone else.

It is obviously quite impossible for the Institute to undertake to produce all the material likely to be required for planting up large acreages. However, what we do hope to be able to do is to provide everyone who wants it with enough cutting material of each approved clone to enable them to establish their own multiplication plots of 100 bushes. These initial nuclei can then be rapidly expanded to meet any possible requirements, since at least 500 new cuttings should be obtainable from each bush within the first three years.

As Mr. Loos pointed out yesterday the distribution of rooted cuttings is attended by the very real danger of also disseminating pathogenic eelworms. For this reason therefore we must insist on all clonal material entering or leaving our testing stations in the form of cut shoots. However, by packing the shoots in polythene bags such as this (SPECIMENS EXHIBITED) it is possible to keep them fresh and in good condition for at least two weeks. The distribution and handling of such material has thus become a very simple affair.

In the past our methods of clonal testing at St. Coombs have developed as we went along, with the consequence that the results of some of the earliest tests, although consistent in themselves, are not strictly comparable with our latest results, using improved technique. Now, however, we are in a position to rigidly standardize the technique to be used at the various stations, so that all results should be strictly comparable. The variations introduced by soil and climatic conditions will, as far as possible, be eliminated by including one or more 'standard' clones in each test series.

One of the lessons we have learnt from our work on St. Coombs has been the necessity of greatly stepping up levels of manuring in order to allow for the very high yields which our better selections have proved capable of giving, almost from the moment they were first brought into plucking. However, I think we now have a

pretty fair idea of the maximum yields likely to be given by first class clonal material. The drawing up of a standard manurial programme to meet future test requirements should therefore present little difficulty.

The subject of clonal quality testing is, however, quite another matter. In the past our clonal manufacture tests have been carried out on far too limited a scale to give us anything like the amount of information we ought to have.

Now quality varies with season, whilst at the same time its general level tends to improve with both age from planting and age from pruning. This being so, it is obvious that two or three manufacture tests, carried out at random intervals during a clone's first cycle of plucking, can only give a very limited idea of its manufacturing potentialities. Furthermore, any special characteristics which it may develop during a particular season may be completely missed.

Far more systematic quality testing of our selected clonal material would, therefore, appear to be highly desirable if we are to make the best use of its manufacturing potentialities. In fact I am inclined to think that test manufacture of every clone, which appears capable of giving the required high yields, should be carried out regularly each month throughout the course of its first cycle of plucking. This will naturally involve a very great increase in the number of test manufactures to be carried out and we, therefore, intend to equip each clonal testing station with a battery of four of the miniature rollers described and illustrated in last September's *Tea Quarterly*.

Regular test manufacture will, however, be useless, unless the characteristics of the made tea samples can be properly assessed. The implementation of this proposal will undoubtedly place a greatly increased burden on the shoulders of our long suffering friends, the Colombo Tea Tasters. Still so long as Mr. Keegel and myself have succeeded in convincing them that the future maintenance and improvement of our existing standards of quality depend in large measure on such tests, I feel sure that they will do their best to give us the additional assistance required in the same generous manner with which they have always so ungrudgingly helped us in the past.

Before concluding I would like to briefly amplify some of Mr. Keegel's remarks concerning the manufacturing possibilities presented by large scale planting of clonal material. Thus, whilst agreeing that selection can provide us with uniform material and so enable manufacture to be brought under better control, I cannot recommend you to take the easy way out and obtain your uniform material by planting up entire fields with the same clone. To do so would be to take a wholly unjustifiable risk, since, as Mr. Webster has already said, we can give no guarantee that any approved clone may not turn out to be extremely susceptible to some new pest or disease, which may subsequently arrive to plague us. To minimise this risk we should accordingly plant up each field in blocks of several different clones, since the odds are very much against all the chosen clones proving equally susceptible to a new pest or disease. However, I see no reason why it should not be possible to make a selection of clones having very similar manufacturing characteristics, if this is what is required.

On the other hand, once the necessity of planting up our fields with several different clones is realised, it may well prove better to attempt some degree of blending our teas in the field and to accept, with as good grace as possible, the increased manufacturing difficulties involved.

In any event no decision on these points is obviously possible unless we know much more about the manufacturing characteristics of each individual clone; which information will not be available to us unless some such systematic programme of test manufacture, as I have previously outlined, is made an integral part of our clonal proving work.

THE FUTURE OF CEYLON TEA

T. Kane

You have been listening to a series of lectures and discussions which have required your closest attention. The time has now come when you can relax. Not that the subject I have been asked to prepare is unimportant, but that it is not the detail which is significant but the general picture. Moreover the information you have received hitherto has been the work of experts, which few of us would be competent to question even if we wanted to, while a paper on the Future of Ceylon Tea is necessarily a matter of opinion with which you are entitled to disagree. As I understand the Director is anxious to stimulate discussion I have not moderated the expression of conclusions of which I am myself fully convinced.

The subject is one which affects us all whether we are actively engaged in production and trade or not, and while some may object that the future is unpredictable, it seems to me reasonable to regard the whole industry as one does one's own business and seek to assess our prospects from current trends. Since the whole of our future in tea depends on demand and supply, I have decided to treat the subject simply under those headings, and although I am to speak of Ceylon tea, I shall have continually to refer to other producing countries with whom we are in competition. The figures I give will be as few as possible and approximate. I am chiefly indebted for them to the Bulletin of Statistics published by the International Tea Committee. I am going to use them to try to discover changes in demand since the pre-war years.

It is of course impossible to say that all the tea produced and sold in one year is actually consumed at the time, but as I propose to take the years 1936 and 1953 for comparison, in both of which years the trend of stocks was downward, there can be no harm in assuming that it was in fact consumed.

Let us start by examining the distribution of demand in those two years in countries where comparative figures are available. The first thing we find is that it has increased very greatly. In 1936 the total consumed was 1,050 million pounds while in 1953 it had risen to 1,350 millions. In these two years the United Kingdom's consumption was 438 million and 463 million respectively. It can thus be seen that the predominant position of the U.K. as a consumer had been affected to a certain extent. Not much of the increased demand has come from that country. There are of course reasons for this well known to us all which we shall examine later, but I think the figures show that even if the balance has shifted slightly, the U.K. market is still of overwhelming importance. Nearly half of all the tea exported from producing countries is drunk there. It is not to be supposed that such a market can be supplied on a hand to mouth basis. A large buffer stock must be retained and producing countries in their own interests must help buyers to bear the financial burden by retaining an adequate market in London. In the absence of such a market, with a regular flow of tea toward it, the recent dock strike would have restricted consumption on a scale to cause an artificial increase in stocks and the disorganization of Eastern markets.

Turning to Ceylon tea, which is our subject, we find that in 1936 exports totalled 218 million pounds and in 1953 had reached 335 million. This is a massive increase. Where has it gone? Who are the people who are prepared to drink 120 million more pounds of Ceylon tea? Well first of all we had made no progress

in the U.K. Whereas in 1936 about 124 million pounds were consumed there, by 1953 the figure had fallen to 107, a change from taking more than half our exports to less than a third. Two obvious reasons for this sharp change are the disabilities under which consumers in the U.K. have been labouring since the war and the need to replace about 70 million pounds of Indonesian tea in the other markets of the world. Indeed when in 1947 tea came to public auctions again in Colombo there was an even greater vacuum to fill for production in Java and Sumatra was practically at a standstill.

Ceylon was in a peculiarly advantageous position to seize the opportunity. In the first place Ceylon tea was the nearest in character to those which had to be replaced, and in the second place Colombo provided a port where adequate freight was available to all parts of the world. Ceylon had a big share in the replacement of Indonesian tea in all its main markets, Australia, the United States, Egypt and the Persian Gulf for example. It is not however only a question of replacing Indonesian tea. There is an increase in world demand of the order of 300 million pounds a year and all these countries as well as others are drinking much more tea than before the war. Europe as a whole has gone back since 1936 owing to the cessation of visible imports into Russia. At the other side of the world Oceania has increased its annual demands for tea by 20 million pounds and Australian imports of Ceylon tea were actually up 40 million pounds. North America is 30 millions up, and Ceylon has managed to increase her own shipments there by the same amount. African imports have jumped from 69 to 139 million pounds and separating North from South we find that the Union of South Africa, whose imports are practically entirely Ceylon tea, has doubled her imports at 25 million pounds while in the North, Ceylon's share has risen from an insignificant 5 million pounds to 29 millions. If I have left Asia till last it is not because it is least important. Ceylon exports to other Asian countries have risen from 8 to 33 millions mostly to Middle Eastern countries, but there is a far more important factor in Asia affecting the prospects for Ceylon's exports of tea and that is the increase in the internal consumption of Indian tea, which is estimated to have risen in the period by 100 million pounds and is still rising sharply.

These then appear to be the main trends in demand for tea at the end of 1953. An overall increase in world consumption. U.K. and European demand static with Ceylon tea losing ground; on the other hand expansion in all markets (except Latin America which I have not mentioned) and Ceylon more than holding her own.

Are these trends going to continue? As regards an increase in world consumption emphatically yes. The standards of living of the masses are rising everywhere and tea is the first and cheapest luxury in which they can indulge. A luxury which rapidly becomes a necessity. What of individual markets? I want to group them and I shall take first the hard drinkers, the U.K. and Australia. I do not think it can be disputed that the present boom in tea is largely due to the impact of a free and increasing U.K. demand on the world's supplies. The disappointments following the ending of rationing in October, 1952 are over, private hoards have been finished, the public are free to choose what they want and, as far as can be seen from the 1954 figures, demand has gone up by about 1 pound a head since the end of rationing. Twenty million pounds more of Ceylon tea has been consumed in 1954 than in 1953. This brings the individual's consumption to over 9 pounds a year and may be attributed to the serving of tea in canteens, more frequent drinking of tea or the drinking of stronger tea. Tea is now drunk in the U.K. as early tea, with breakfast, in the mid-morning, after lunch, at tea time, high tea time and at supper. It is difficult to see when else it can be drunk if any time is to be left for work. In the same way in Australia 9 to 10 pounds a head is drunk by every man, woman and child. The population rises by births and immigration by some 100,000 a year and as each infant and immigrant learns immediately to drink tea on the full scale, consumption may be reckoned to go up by 1 million pounds a year. By and

large I should regard these markets as now saturated and likely to increase their offtake only in accordance with a rise in population.

Next we have what I call the longstanding competitive markets, the Continent of Europe; the U.S.A. These are on the whole disappointing markets where, as the Red Queen said to Alice, you have to run very fast to stay where you are. It is very hard to induce a Frenchman to believe that tea is a better drink than coffee, many people in Europe lost the tea drinking habit when supplies were cut off during the war and many countries are not now readily accessible. In the U.S.A. the competition from beers, soft drinks and coffee is very severe and any success in the campaign for selling tea means increased advertising by our rivals. In spite of the progress reported by the Tea Council, I am doubtful of our doing much more than hold our own. Canada, with its immigrant population of tea drinkers, seems a better prospect for development, but in these markets the wealth of the individual makes the comparative cheapness of tea of less importance and we have to face our rivals mainly on quality.

So far the picture is of a sharp increase in U.K. consumption with the possibility of further slow but steady progress all round. Before passing on I must glance at the South African market. As I have said good progress has been made by Ceylon tea there, but the special point about this market is that, if we do not confine ourselves to the Union, we are talking of headway made in a producing area. Not only is there a discerning public which prefers Ceylon tea straight, but Ceylon teas are used for blending to make the cheaper packets of African tea more attractive. This means that the development of tea growing in Africa is not necessarily a menace to good quality Ceylon teas.

And now we come to those markets which in my opinion change a generally sound position into one with the promise of years of boom prices—North Africa, the Middle East and Asia. Four things have fundamentally altered the effective demand in these areas—wealth, democracy, transport and propaganda. The development of the oil industry in the Middle East has brought tremendous wealth to countries which were previously very poor. The settlement of the Anglo Persian dispute brings another good buyer back into the field. With the spread of democratic thought it was impossible for this wealth to be confined to a few hands and wages are rising all over the Middle East. A good deal of transient wealth followed the armies which occupied and defended these areas during the war. Now we have the Colombo Plan, India's Five Year Plan and American Aid, all designed to raise the standard of living in Asia. Tea is the first luxury, and every man who has access to it gets his packet or drinks his cup. Roads are being improved and vehicles built which can travel where no roads are. Where they go run the vans of the big distributors seeking sales. Moreover those same armies to which I have referred took with them the tea habit and the habit of drinking it good and strong. More money is in the hands of the people and more tea is being drunk. This is a process which has only begun in these areas. Moreover the market of the greatest potential value of them all is the one in which we shall never sell a pound of tea—India. If every Indian drank 1 pound of tea a year there would be no exportable surplus of tea there. An increase is going on and is cumulative. One month a tea van reaches a village, the next the shop is stocking tea and the next it is in every house. Tea is not the vital export to India that it is to Ceylon and it may well be that the Indian Government will protect its internal market by limiting export licences. Indeed for the last two years they have not issued the full quota permissible under the International Agreement. The prospect for Ceylon is not only of filling an increased demand but of replacing in part Indian exports to all other countries.

Now if we are going to take advantage of this opportunity we must know what these consumers want. The scientists have never really liked normal manufacture and have hoped to approach something more like the production line. There would

be a considerable saving in building and working costs if such methods were successful, and, as demand for some years has increasingly been for high percentages of B.O.P. and B.O.P. Fannings, the prospects are worth examining. Roughly the process would be that instead of being spread in lofts the leaf would go into withering drums, from there to the roller where in one brief process it would be crushed and ripped, a normal fermenting and firing would follow and then perhaps the tea would be graded by winnowing and packed automatically.

The withering drum is with us already and is I think going to save a great deal of money which would otherwise be spent on factory extensions. There seems no reason why an artificial wither in a drum should be worse than one in a loft. We are however a long way from finding a substitute for the natural wither. Not many people appreciate the economics of fine teas; they are very expensive to produce. When an estate is yielding only 25 pounds per acre for the month, the cost is very high indeed and every bit of quality must be preserved. The big profits are made out of rush teas.

The real bone of contention is the rolling. Normal rolling is slow and produces a variety of grades. The tearing method without modification produces 100 per cent. broken leaf. Normal rolling bruises the cells and firing seals them with their own juices. The tearing method rips them open and firing fixes their juices on the flaky surface. Tearing produces strong coloury liquors with equal quality to normal. It is maintained by the trade and as hotly denied that these flaky teas do not keep.

I am prepared to maintain that the tearing action is wrong in principle, but however that may be one thing is certain—teas made by this method have no 'appearance'. The scientist laughs at the consumer for choosing his tea for its looks, but it is not so foolish as it sounds. Under normal manufacture it is possible within limits to tell by eye what you are getting. Coarse plucking shows up at once, as stalk and fibre, and the housewife is quite right to object to too many strangers in the tea. Torn up leaf even of good quality is brown and fibry. This not only leads to floating particles in the cup but tempts the planter to get away with longer rounds and coarser leaf. The fact is that the tearing method offers no advantages to the consumer, only to the producer, and the consumer pays. It is true that in the U.K. a proportion of such teas can be absorbed by the blenders, but too much cannot be used without upsetting the weight/volume ratio on which their packeting depends and to change their machinery would be expensive. The lighter flaky leaf also increases freight charges. More important still, in the growing markets to which I have referred, their appearance is quite unacceptable and even the type of liquor is not favoured.

The U.K. is still the most important world market for tea but the proportion of the world's output consumed there is diminishing. We may have reached the end of the cycle in which the best average price was obtained for high percentages of small leaf B.O.P.s even when of ragged appearance. The developing markets in the Middle East demand teas with a jet black leaf, a show of tip and bitter liquor. These teas are largely produced in the low-country by short plucking rounds and light rolling. The obvious answer is that high and medium grown estates should concentrate on producing teas for Western markets while leaving this field to the low-country producer. The fact is however that even now there is not enough of this type produced, and well made mid and high grown tea can enjoy the best of both worlds. Many a planter of high grown tea has boasted of the price of his Fannings without realizing that it is being shipped to Egypt as a result of the buyer for quality being outbid by a man who values it for its black leaf. The people who make their tea with the waters of the Nile, Euphrates and Tigris, drink it largely in glasses without milk and heavily sugared and spiced. They value most the bitter tang of well brewed tea and their taste is just as valid as ours. For years now low-country tea has tended to average more than mid-country teas of admittedly

better quality, and at times it has paid handsomely when certain estates have abandoned the search for quality and imitated low-country manufacture. Without going so far as that, good plucking and normal manufacture will give certain grades of high and medium grown tea access to this developing market.

Moreover it is not only in these markets that the production line manufacture fails to satisfy the client. For instance these torn up teas cream richly. Now you might see one row of cups set out to cool in London and another in Boston. In London it would be done to select those that creamed but in Boston to reject them, for the teas to be sold iced in glasses must be bright and transparent to make them look as attractive as they taste.

Even the despised O.P., which now constitutes perhaps 1 per cent. of Ceylon's manufacture, has its own special market which would have to be reconquered for tea if O.P. was no longer available. The Continental drinker of thin flavoury tea with a squeeze of lemon might be lost completely. Turks and South Americans both like O.P.; I confess I do not know why. It may be that the tightly rolled leaf keeps better when long distances and poor communications make for delays in reaching the consumer. It may be that the demand is part of the transition from green tea. My experience of Ceylon green tea is confined to my earliest days in the trade and the test I used to apply was that the more it looked and tasted like hot water the better it was. A light liquoring tea may suit such palates best, though I believe in South America it is brewed for a long time in large jugs and comes out very strong.

The black leafed knobbly Pekoe is much in favour in the packet in the U.S.A. where appearance is important and though tea bags are widely used, woe betide the seller whose bag shows little fibres jutting through. For all these reasons normal manufacture is to be preferred and medium and high grown estates may find it desirable to use those shorter rounds which avoid the plucking of coarse leaf and allow high B.O.P. and B.O.P.F. percentages to be produced while retaining good appearance.

Before leaving the subject of demand, the question of price and consumer resistance must be considered. In the U.K. the standard unit is now the quarter pound packet. In 50 years it has almost completely replaced the chest of loose tea in the grocer's shop. There are a great many advantages to the packet. The name on it is a guarantee of fair measure and against adulteration. Quality and freshness are maintained at an even standard throughout the year and tea is blended to suit the waters of the district. But when a quarter pound or more of tea is bought at one time and there has been a sharp rise in price, the extra cost makes an immediate impression. I don't say the consumers now cannot afford present prices. Wages have risen tremendously since before the war and the price of rival drinks has risen much more steeply. The attempt being made to encourage the use of tea bags, which are expensive by comparison, seems to show confidence in the public's buying power, but there is certainly a chance of people drinking weaker tea—perhaps drinking it less frequently.

Tea drinking in the newer markets is in a more elementary state. In the early years of the century poor people in the U.K. bought loose tea by the screw, the half penny screw, and this was a most profitable way of selling tea. The grocer twisted a small quantity of tea up in a small square of newspaper and adjusted the quantity in accordance with the price he had to pay for tea. The point is that a lot of money was paid per pound while the individual only expended a small sum for a small quantity of tea. In the developing markets of Asia and Africa we are still dealing with annual consumptions of less than 1 pound per head. The packet system with its advantages of freshness and brand name as guarantee of purity is now general in India and Egypt, but the most popular is a very small fixed price packet of unspecified

weight that sells for the equivalent of a few cents. This is the equivalent of the screw. The demand is not likely to be checked by high prices. The buyer does not see the rise. Having brewed his tiny quantity to exhaustion he will buy another packet since the money is now in his hands.

To sum up, the world wants tea. Our rivals are consuming more and more of their own production internally. There is a tremendous opportunity before Ceylon.

It is when we turn to supply that this rosy picture fades. The Tea Propaganda Board, Tea Councils and neighbourly example, are stimulating tea drinking in all countries and there is no hope of our satisfying this growing demand within a period of six to seven years even if an immediate start is made. Let me quote the figures of Ceylon's tea production—in 1936, 226 million, in 1954 367 million pounds. This increase has been achieved by cultivation with an insignificant increase in acreage. Larger and larger applications of manure have been made, measures for the control of pests are universal, vacancies have been supplied and Ceylon now has a finer cover of tea on her plantations than ever before. There must however be a limit to the yield of our present estates planted as many are at 3,000 or fewer bushes to the acre, and that limit must be near. Adverse weather can at any time set us back from the level already reached. In the first half of 1954, 20 million more pounds of tea were produced than in 1953, but in the last six months growth was checked and crop was barely maintained. Here too are some ominous figures. Between 1921 and 1931 estates and small holders opened up 100,000 acres in tea in Ceylon. Between 1936 and 1953 the figure is only 15,000. It is true that our rivals are in much the same case. India and Pakistan have only increased their acreage by about 20,000 acres in the same period though they have probably done more replanting. In Indonesia there has been a disastrous fall in acreage. This is a point that should be remembered in talking of a recovery in Indonesian exports. The tea is not out of plucking, it has been uprooted or overgrown and is not available for rehabilitation. Internal consumption is increasing there as well as in India. Nevertheless, if we delay further, either country may rob us of our opportunity by fresh planting.

Now who or what is to blame for the almost total cessation of development in Ceylon's tea acreage? Certainly not the International Tea Committee. The quotas allowed under the Scheme for replanting and fresh planting have never been taken up in full and there has never been any need for an official request for an increase. There are four causes, the great slump, the war, bulk purchase and taxation.

It was not to be expected that there would be much expansion while existing plantations were working to 85-95 per cent. of their standard production, (let alone their potential production), and during the war new planting was not possible. The war has however been over for nearly ten years and the whole of that time has been wasted. I do not know which of the evils, bulk purchase or taxation has done the more harm. The one prevented the price of tea from being realistic and the other prevented the producer from reaping the benefit of high prices. Since bulk purchase is no longer a menace it may as well be dealt with first. When auctions were restarted in Eastern markets in 1947 the U.K. Government, was haggling over a 2*d.* rise in the contract. Auction prices soared and the U.K. obtained tenders for considerably less than its requirements. The unfortunate British consumer was ground down to a minute ration and prices in Eastern markets declined owing to the larger supplies available. The poor price offered in 1948 again kept tenders and the ration low while the remaining tea was absorbed at falling prices in other markets.

A kind of cycle was established. Towards the end of a year out-markets would increase their buying in anticipation of the U.K. contract. Prices would rise. The contract rate would then be disputed between the Governments. The quantity

demanded by the U.K. was always so large as to frighten out-markets into maintaining the price level. During this period wage claims were granted and taxation was raised. Once the contract was made for a comparatively small quantity prices on the open market fell but not wages or taxation.

The effect of these manoeuvres was to push the sale of tea in markets other than the U.K. but to disappoint producers, who all this time had to contend with sharply rising costs. In 1949 therefore tenders were far more heavy. 130 million pounds in all were under contract. The effect was that the balance sold on the markets was inadequate to satisfy demand and prices soared. When 1950 came the level was such that the Ministry offer was quite unacceptable to the Ceylon Government and producers. A Government monopoly however wields tremendous power. The Ministry of food refused to buy in the open market and stood out grimly till July when Eastern markets broke. They then had to make do with a promise of 100 million pounds by March, 1951. The ration was again cut shipments began and Eastern markets recovered. That was the end of bulk buying but it was unfortunately two more years before the aftermath had cleared; rationing and price control continued to limit the consumption of the world's biggest tea drinkers and depress prices. It was during these years that the British housewife built up those hoards which helped to disorganise marketing when the restrictions were at last removed and led to the crisis of 1952 when there was more thought of closing down estates than of development. It is only now that the U.K. has resumed her rightful place as a buyer.

All this time while bulk purchase has been operating to depress prices, costs have been rising and our own Government has been taking a larger and larger share of gross receipts and any residual profits. Income tax and profits tax and special levy become more and more severe, while export duty has been raised, raised and raised again, only being belatedly relaxed at a time when it was clear that it was being paid out of losses. The export duty is a direct tax on the producer regardless of his profits. I know of only one occasion when it can be said to have been paid by the consumer, the occasion when the duty was raised immediately following the conclusions of a bulk purchase by the U.K. In that case it may fairly be said that the British consumer paid it. The duty is far more severe in Ceylon than in any other country and the Government's policy of taking the bulk of profits from increasing prices by this means deters any outside capital from investing in new planting here, and makes any large scale efforts by the present companies impossible. We may note that licences for the opening of 50,000 acres of new tea in Africa have been granted. There is no export duty in Africa.

The excuse given by the Government is that the industry can bear it—or that they are syphoning off excess profits. Both these excuses show a failure to grasp the urgency of development in the industry. It is true that at present prices the industry can afford the tax in that handsome dividends can be paid. This money however is not available for development but passes through the shareholders hands back to the Government. At the same time costs are rising and pushing up the minimum economic yield on an estate. Wages and housing standards rise, more protection from pests is required, more manure. The margin of profit is continually narrowed unless yields can be pushed up. Before the war an annual crop of 500 pounds an acre was usual. After the war buyers looked askance at any property not yielding 650 pounds, and today I should consider any property not yielding at least 750 pounds an acre as a risky long term investment. The average yield per acre in Ceylon including small holdings on 1954's record crop is only 650 pounds per acre. A considerable area of tea particularly in the mid-country would become uneconomic if prices were to return to a more normal level.

The so-called excess profits are in fact the new capital which should be developing the industry and they only appear excessive as they are based on a capitalization

which is quite meaningless today. Consider the cost of replanting. It is a fact that modest extensions in acreage on estates, already possessing factories, buildings and roads, now cost fully Rs. 3,000/- an acre. If it is a question of replanting, when the land has to be cleared, contoured, rested and rehabilitated, it must remain out of production for an extra year and perhaps another Rs. 1,500/- an acre in costs must be added. Moreover this resting and rehabilitation is essential. No new areas are going to be worth while unless double the old yield is obtained. The figure to be aimed at is 2,000 pounds an acre.

If these are the costs of a new clearing how much more must be added in the case of a new estate? Well a factory to handle a million pounds a year on a new 500 acre estate could not be built for less than 7½ lakhs and you can add another 5 lakhs for housing and roads. Cut out the land rehabilitation and suppose you have obtained virgin jungle free and you have a cost of the order of Rs. 6,000/- an acre. That is the least that new planting is going to cost. If it is to be worth anyone's while to do it there must be the prospect of a return for the investment and the simple sum is that 10 per cent. on a capitalization of Rs. 6,000/- an acre is something better than 60 per cent. on a capitalization of Rs. 1,000/-. With the higher yield the 10 per cent. will be earned more easily but the point is that the best of the older plantations are now capitalised at levels which have no bearing on the money put into them or their present value. Until the Government is prepared to recognise the urgent need for the country's future for large profits to be retained in the hands of producers, development cannot begin.

We can only have faith that the Government will realize the importance of development and meanwhile be prepared to go ahead as soon as there is any encouragement. Unfortunately there is still a lot to do before any large scale replanting can be undertaken. In view of the cost of it, eventual yields must be high and seed cannot be relied upon to give us the right bushes.

For years the T.R.I. and enthusiastic planters have been busy studying vegetative propagation and selecting high yielding good quality pest resistant clones. A good deal of success had crowned their efforts particularly in finding clones suitable for western high and mid-country districts. Much remains to be done in selecting clones suitable for propagation in other districts or testing the existing ones there.

The urgent need now is for the multiplication of the existing material as any large scale replanting will be impossible until enough cuttings are available. Moreover, companies will have to survey their estates with a view to selecting the areas they propose first to replant. Ideally a start should be made on fresh ground to avoid a drop in crop which can be ill afforded. Many estates however have not the land and the poorer areas of tea may not be worth replanting at all. There is already a terrible time lag in any case before supplies of tea can show a significant increase from this country. During this time prices are likely to remain very high, but, far from this being welcome, it is an encouragement to our rivals, not only to other drinks like coco-cola and coffee but to the one vast enigmatic producing country which I have so far ignored—China. No one knows how much tea is still available there and what export surplus exists, but if China is to re-start trade with the outside world, tea may very well be one of the commodities offered. The world has largely lost its taste for China tea but competitive prices might change the situation again.

Let me conclude then with the action that should be taken to protect the future of Ceylon's tea trade. By the producer the immediate laying down of multiplication plots of clonal material and the preparation of a plan for expansion or replanting. By the Government either the lowering of taxation or the granting of a replanting subsidy of the order of Rs. 2,000/- an acre. It is said that there is no land at higher elevations which is suitable for planting and can safely be cleared. I should like to see that statement tested. The hills of Uva are still only partly developed. Is

well grown tea with heavy shade a menace to rainfall? Is the chief need for a bigger area in the low-country seeing that the new markets seem to prefer low grown tea? The Government has an interest in answering these questions both for revenue's sake and as a means of increasing employment.

The International Tea Committee should relax restrictions on replanting completely until it is apparent that they are needed again. It seems absurd that planting in Africa should be uncontrolled while Ceylon and India are restricted. Looking back it can be seen that one of the healthiest periods in the Industry was 1936/39 when there was an adequate acreage available to expand production to meet demand and machinery to control production if prices fell too far.

Unless we can get back to such a position we face the prospect of a few years of high prices and then contracting demand, or else replacement of our high cost tea by that mechanically plucked by others, say an Australian earning wages of £20/- a week as he mows it off the hedges of New Guinea.

SELECTION AND SEED PRODUCTION POLICY IN ASSAM

W. Wight

(Senior Botanist, Tocklai Experimental Station)

I have been asked to speak on the subject of tea breeding in Assam. This is a large and complex subject and I will therefore confine myself to general principles which affect the practical man.

Organised tea breeding at Tocklai started in 1940. We estimated 20 years before any results could be expected. I did not return from the Army until 1946 so that much delay was caused. Now we do not expect to produce anything noteworthy before 1965.

There will remain the question of trial in districts and also commercial production—it takes time for new baries to come into bearing.

Some principles have been established. We can see the possibility of selecting improved seed bearers—this really means the rejection of a large bulk of inferior material. More constructive breeding looks further ahead to the production of new kinds of plant not to be found naturally. However, this does not prevent us from sorting out the best from what we already possess.

I need not deal with practical procedure. The point I wish to make is that it is now very largely the duty of the Assam seed producer to do his own selection by methods which seem to be of immediate value. More difficult breeding problems can be left to the technician and to the future.

This means that the seed producer must learn how to select and must devote time to the examination of very large amounts of material. If necessary he must be prepared to do experimental manufactures of trial progeny; and then follow this by vegetative propagation of a few selected trees so as to make many acres of seed bari.

Companies devoted entirely to the commercial production of tea seed seem to be necessary for real progress. The presence of large and competitive seed companies in Assam has been very largely the reason for the Assam custom of replanting.

In the early days of the industry, talented practical men discovered that appreciable improvements could be made by very elementary selection. This started in the Surma Valley but eventually the greatest progress in the commercial production of seed was made in Upper Assam.

Nothing was done in some other districts which require a kind of plant different from that which was selected in Upper Assam.

In India, Upper Assam has attained pre-eminence in tea production. It is favoured by climate but has also been favoured by large scale production of the kind of seed required by that climate.

Experimental work at Tocklai has shown better methods of selection to be possible; and the planter is as eager now as in the past to take advantage of every possible improvement. Vegetative propagation is one of these possibilities.

Four seed baries are being established in Assam by vegetative propagation. In two instances a special staff has been employed since 1946 solely for the purposes of selection and vegetative propagation.

Other baries are being established by mass selection of seedlings. In all cases men have received some form of training for this work.

Those who are likely to lead are those who depend for their living upon the sale of seed—or who are obliged by contract to supply all the internal requirements of a company.

In the past, good seed has been produced by men willing to devote time and capital to the production of tea seed for sale in a competitive market. The same will apply to the future.

Because the progress possible at present depends upon a sorting out of existing material, it is best done in many centres and amongst material known to be of local merit.

This sorting out takes two forms:—

(1) Nursery selection of seedlings. Each tree in the new bari will be selected but will differ genetically in some respects from all others. Very large numbers of plants are required, those acceptable being of the order of one in a thousand. This means 999 rejects for every plant accepted. As wide spacing in the nursery is essential for rapid selection, we reckon that an acre of nursery is desirable for every acre of potential seed bari. Smaller nurseries can be used if the same amount of seed be more closely spaced with a lesser number of pathways; but this makes the selection of such a large amount of material more difficult.

The original nursery can be the site of the final bari, so that the land requirements are not so excessive as appears at first sight. The rejected plants can be removed and used as supplies.

(2) Selection of about ten desirable plants which are multiplied by vegetative propagation to make a polyclonal bari. The advantage of this method is that if the bari is successful then it can be repeated in any number of localities without the need for further selection.

There is a greater element of risk in this method. It is desirable to establish trial nurseries and necessary to build up nucleus clones to provide a supply of cuttings. At least five years initial work is required before one can hope to start on a new bari. This method is being used by one large tea seed company.

The best jats we can produce by either method will contain bushes which are superior to others in the jat. Similar superior bushes occur with lesser frequency in existing jats. Many of these will not breed true, or if seed is taken from them then a good deal of the superiority will be lost.

Such bushes can be propagated vegetatively. For this reason planters in Assam who are making new seed baries are also selecting leaf producing clones for vegetative propagation. The two methods are complementary.

Many of these clones will have individual merits likely to be in demand by the blender.

If improved seed be generally used then individual advantage will be lost. In these circumstances 20 acres of a clone selected on a particular garden is likely to give a distinctive mark to that garden and to be of great value during quality periods.

For this reason great attention is being paid to garden selection and propagation of clones.

Probably one quarter of all the acreage in Assam is useful for selection. We estimate that every 14 acres of this fraction contains one bush of outstanding merit—easy to propagate, of reasonable yield and likely to make tea which will be in demand.

Some gardens are making a practice of working through 14 acres (or thereabouts) annually. Something of the order of 4,000 bushes are selected on the basis of hair on the leaf. This gives a heavy bias towards the kind of plant which is required in Assam.

Selection amongst these 4,000 bushes is then repeated for yield by methods essentially the same as those used in Ceylon. The anticipated selection is of the order of 200 bushes. Cuttings from these are tested for ease of propagation. This is followed by a small scale yield estimate based upon early stages of growth of the cuttings. This is combined with miniature manufacture and tasters' reports. After this, a nucleus clone of about 300 bushes is aimed at. This is to be the source of cuttings for replanting in the garden.

As the outcome of work along these lines, sections of the order of five to ten acres are now being planted by a few gardens.

Our earlier methods differed somewhat from the procedure which I have outlined. Various modifications are possible according to circumstances. A slightly different procedure is being used on a large scale by the Scientific Officer of one company. But in all cases the magnitude of the work is of the order which I have indicated. It is being done on tea gardens by the tea garden staff.

There have, naturally, been some set-backs. People have failed to handle material properly and have lost cuttings or plants. This is why it is necessary for the practical man to get on with the work, as no progress is possible until sufficient horticultural skill has been acquired.

One company employs a special staff for this work.

In one garden in Darjeeling propagation was so successful that seed orders were cancelled. Tea seed is not grown in the Darjeeling district. Clones raised on the garden were more successful than imported seed.

The characteristics of Darjeeling tea probably depend upon a hybrid plant and in these circumstances it may be better to use clones.

Further advances are always possible by further research. Progress depends upon using existing improvement. One does not refuse to make a motor car because research on turbine engines is not complete. The research worker produces a blueprint. It is the practical man who has to take off his coat and make the cars in quantity.

My impression of the tea industry is that very often the practical man does nothing and gives the reason that he is waiting for research to be completed. In the progressive part of the tea industry research will never be complete.

Practical application of vegetative propagation will carry us a long way forward. In Assam, local selection of the unique bush which we suppose to occur in every 14 acres would make use of existing knowledge and would also provide the breeder with material of great value for making further advances.

Not to do this might handicap future breeding as no research station could possibly select over so much material as already exists on tea estates.

The broad policy which I have indicated is that which is developing in Assam. It deals with the practical exploitation of valuable combinations of cup characters which exist naturally and are easy to grow and are adapted to the district in which they are selected.

In time the trade might ask the breeder to produce an unusual balance of several attributes all combined in one plant—possibly to do away with the blender. Such a plant, if produced, might, in the first place, fail to develop an adequate root system. This would be a problem to engage the research staff, rather than the selection of existing material by known methods.

In short, research policy is visualised as the production of unusual kinds of plant by what one might call synthetic breeding. This must be regarded as a long term but very necessary policy.

By practical advance we mean the immediate exploitation of present knowledge. We expect the practical man to do this.

Immediate improvements in seed supply are possible. For this we think several specialised and competitive seed companies are necessary.

We think improved seed is not sufficient and garden selection of vegetative clones should proceed continuously.

To realise the possible practical advances needs a precise and objective programme. We think this should be devised by company representatives in consultation with the scientific staff at Tocklai. A particular programme applicable to the requirements and circumstances of the company should be laid down. We consider this must be made the sole duty of some person with administrative ability and horticultural talent.

In conclusion I must emphasize that the outcome of the applied work now in progress in Assam remains to be seen.

So far as it is possible to draw conclusions from experimental work on a limited scale, then the applied work is justified.

Replanting is a fixed policy in Assam and is always going on. Once a section is replanted it does not pay to uproot for many years even if much better material is available. It is therefore essential for us to make immediate use of even the slightest improvement or possible improvement.

At the close of this address a number of questions were put to Dr. Wight by the Director. In view of their general interest Dr. Wight's answers are reproduced below:—

Question 1.—Does Dr. Wight think that anything would be gained by putting out our best clones, say 2024, into seed bearer areas?

Answer.—Many of the clones selected for vegetative propagation will not breed true. If they are introduced into an existing seed bearing area the result might be to make the jat more mixed than before. Used by itself, a single clone is likely to produce either no seed at all or else a very small amount of inferior seed of poor germination.

Question 2.—Would Dr. Wight advise us to put out mixed areas, say 2024 and 2025?

Answer.—This question is essentially the same as the foregoing, but by using only two clones, the danger of obtaining unsatisfactory results is greatly increased.

The choice of a pair of suitable seed bearing clones is work for a specialist, and would take about 20 years.

There is no guarantee whatever that clones suitable for vegetative propagation will be suitable for seed production. I would say that most clones selected for vegetative propagation are unsuitable for seed production.

I have examined 2024 and 2025 and consider that a combination of these two might give very unsatisfactory seed.

Question 3.—Does Dr. Wight think that the T.R.I. could achieve anything by running comparative nursery trials of seed taken from existing seed gardens?

Answer.—Similar work in North-east India has taken seven years. A large area of land was occupied by the trials. After what I have seen of seed bearers in Ceylon I would say that the time and land would be better used for tea breeding. Seven years comparative trials would produce nothing new and would be one third of the estimated time required to produce improved seed bearers.

SOME OBSERVATIONS ON THE FINANCIAL ASPECT OF REPLANTING CEYLON TEA

Gordon K. Newton

(Visiting Agent, St. Coombs Estate)

(Note:—The Hon'ble the Minister of Agriculture and Food arrived at 11-00 *a.m. on the second day of the Colombo Session to deliver the closing address and was welcomed by the Chairman. Before speaking he agreed to listen to the following addresses by Mr. Newton and Mr. Pathmanathan).*

Before I attempted to piece together evidence of costs of tea replanting in practice in Ceylon, I made inquiries from various sources, to find the scale of work done on any one estate (for which I could get details) was so small as to be unrepresentative of commercial tea plantations. The figures given by the Superintendent of St. Coombs are for work carried out at the T.R.I., not on a very large scale but sufficient on which to base estimates for larger programmes. Recorded crop figures from areas planted in clonal stock at St. Coombs indicate yields of 1,000 pounds per acre in the third year from planting, 1,500 the fourth year and 2,000 from the fifth year, which may be expected on other estates under similar conditions as St. Coombs. I would like to emphasise the point of similar or fairly similar conditions being a pre-requisite to such results.

The tea sale averages for Ceylon teas sold at the Colombo Auctions since bulk purchases ceased in 1947 (8 years) up to 1954 have been:—

Up-country tea	211 cts.	per lb.	average
Mid ,, ,,	183 cts.	,, ,,	,,
Low ,, ,,	184 cts.	,, ,,	,,
Total all sales	194 cts.	weighted	average

These averages include two boom periods.

Tea prices are notorious for variability; the present boom cannot be expected to last and average prices at lower levels seem likely to be re-established.

On this premise one has to try and fix, with data at present available, when replanting old tea by high yielding selected clonal plants becomes an economic proposition. Since so little replanting on a commercial basis is being done in Ceylon, it is not out of place to associate that fact with a share market on which tea can be purchased at Rs. 2,000/- or less per acre and sales of fully equipped tea properties go through at less than half the cost of planting and equipping estates at present. A prospective investor will naturally buy shares or an estate and, unless some encouragement is given to those prepared to put fresh capital into the tea industry of Ceylon, it is unlikely much new opening or replanting can be expected.

Investors in Asiatic agricultural products look for at least 10 per cent. on their capital, so let us, for the purpose of this discussion, take 10 years as our yard-stick.

Tea estate owners will not be interested in replanting high yielding areas; it is the low yielding tea where losses are incurred during lower price periods that come for attention.

A survey of cost of producing Ceylon tea was recently undertaken by a firm of business consultants, covering a cross section of estates where 244,000,000 pounds of tea were produced in 1953 out of a total of 343,033,548 pounds, being 71 per cent. The figures are therefore significant.

They show that after allowing for the last wage increase in August, 1954, 34.59 per cent. of the tea coming under the survey was produced at more than 175 cents per pound, a cost with very small margin below the average price for mid and low country teas between 1947 and 1954, and what is more significant, 20.13 per cent. of the total was produced at 185-210 cents per pound.

Thus there must be a large proportion (possibly 12-15 per cent.) of Ceylon tea which, except for boom periods, is uneconomic to keep in production.

So far the figures I have given are factual, being taken from various publications and records. Taking the 10 year purchase period as the yard-stick, and assuming replanting is to be done over those areas which (on an average) are marginal or nil profit earners, and adopting the figures evidenced at St. Coombs, we get a picture showing the first two years for soil rehabilitation. This is followed by 2 years of maintenance, then 2 years of partial bearing and full bearing for the next 4 years. We know that over a number of years a proportion of the existing tea does not show a profit. Since the small amount of tea such areas give is profitless except to reduce overheads, nothing will be lost by uprooting it. For the first 4 years involved there will be no return from the area for replanting, for the 5th year one may expect a yield of 500 pounds (this is considerably lower than the figure recorded by the T.R.I.), for the 6th year 1,500 pounds, and for the 7th, 8th, 9th and 10th 2,000 pounds per acre, making a total crop for the 10 year period of 10,000 pounds or an average of 1,000 pounds per acre.

Years	1	2	3	4	5	6	7	8	9	10
Crop	Nil	Nil	Nil	Nil	500 lb.	1500 lb.	2000 lb.	2000 lb.	2000 lb.	2000 lb.

The cost taken from the T.R.I. records has been Rs. 6,000/-

If the replanting work is done under revenue account, allowances under Section 7 of the Income Tax Amendment Act. No. 28 of 1954 may be calculated for; according to the ownership, the allowance will at present be not less than 34 per cent. and may be up to 50 per cent.

According to the market one might expect a profit per pound of 10 cents to 60 cents over the 10 year period, taken in steps of 10 cents, being profit at:—

Cents			Total % profit on replanting cost	Annual % profit
10×10,000 lbs.	=	Rs. 1,000.00	17%	1.7%
20×10,000 ,,	=	,, 2,000.00	33%	3.5%
30×10,000 ,,	=	,, 3,000.00	50%	5.0%
40×10,000 ,,	=	,, 4,000.00	67%	6.7%
50×10,000 ,,	=	,, 5,000.00	83%	8.3%
60×10,000 ,,	=	,, 6,000.00	100%	10.0%

At a profit factor of 60 cents per pound the dividend return of 10 per cent. is attained. Another way to read this table, for costs less than those shown at Rs. 6,000/- per acre, is to read the profit column down until the stage is reached for actual cost of the work done. Thus at Rs. 4,000/- per acre 10 per cent. profit is attained at a 40 cents margin. At 60 cents margin the return is 15 per cent.

Areas which are not totally unprofitable but capable of improvement by replanting have to be considered differently. Say the tea concerned is giving 500 pounds per acre and the average profit 20 cents per pound, for 4 years the owners will lose Rs. 100/- a year or a total of Rs. 400/- for each acre replanted, add replanting cost of Rs. 6,000/-, making a total charge of Rs. 6,400/-. From the 5th year onwards 10,000 pounds of tea is estimated for cropping and the margin between sale and production prices is likely to be wider on the higher yield. To cover expenses and loss of income the profit will have to be 4 cents per pound more than for replanting totally unprofitable tea.

On the same formula figures for various combinations of profit factor and yield may be worked and tax relief calculated.

Tax relief is given where owners are prepared to use some of their profits, but there is no attraction for the new investor who can buy tea shares or estates at a level of Rs. 1,500/- per acre upwards.

The present situation is quite unfair on tea estate companies and proprietors who have their revenue reduced by a heavy export duty; rubber estates are being assisted to replant by a rebate from export duty, why not encourage tea producers similarly?

COMMENTS ON MR. NEWTON'S VIEWS

S. Pathmanathan

(Chairman, Low-Country Products Association)

Honourable Minister, Chairman and Gentlemen,

I fully endorse all that Mr. Newton has stated today. The trouble with the tea industry is that the existence of taxation is so onerous that it hardly leaves any profit for expansion and development of the industry. In 1953 I had the privilege of listening to your budget speech, and I can say that you have always laid emphasis on the development of our industries.

We are not grudging that Government takes a reasonable share for development of the country, but we must be convinced that this development does go hand in hand with the development of the agricultural industries. When we criticise Government in this connection please do not be misled into thinking that we are against the Government—we entirely support their policy and we entirely believe in their democratic way of life, but the trouble is that taxation has been going up indefinitely and there is in so many of us a sense of frustration. Are we to expand? and if so from where are we to find the money if we do not get some sort of encouragement from Government, in some way or other?

In your 1953 budget speech you laid great emphasis on capital development to help existing industries, but we regret to say nothing of this sort has been considered as far as the tea industry is concerned. We look forward to you, Sir, as our leader holding this very important portfolio, to assist us at this crucial period. As Mr. Newton pointed out a portion of the income from the export of tea might be funded for new planting and replacement of some of our worn out areas which have been almost over 60 years in existence.

In Australia, when there is a boom, all the surplus from the boom is diverted to the benefit of the industries concerned. In the colonial territories, for instance West Africa, the Cocoa Marketing Board assists the cocoa industry out of the excess profits they make and they get vast sums of money with which to assist the industry.

I have great pleasure in supporting Mr. Newton's contention that Government must give us speedy relief if we are to achieve this object of replanting our worn out areas.

CLOSING ADDRESS BY THE HONOURABLE MR. J. R. JAYEWARDENE, MINISTER OF AGRICULTURE & FOOD.

Mr. Chairman, and friends;

I have read the papers submitted to me with great interest and I am only sorry I had not been given an opportunity of reading the more technical papers—I wonder whether the organisers thought I would not understand them! I shall be very pleased to be given the chance of reading these; I am sure they will be as interesting as the ones I have read and I trust I will be able to read them when they finally go into print, as the papers I have already read were very interesting and useful and gave me very many ideas.

I am also very glad to hear of the response you have had to the invitations sent out and also to know that 90 per cent. of those invited have attended the Conference. That in itself is a tribute to the triumphs of the Tea Research Institute over the enemies of the industry, I do not mean the Government, I mean blister blight. The future of the industry is very closely bound up with the future of the Tea Research Institute, and this is proved statistically by the fact that the producer is following closely the recommendations of the Institute. The record yield of 1953 has been broken in 1954. Let us hope that 1955 will eclipse all previous years.

I need hardly stress a matter that has been stressed in your papers, the necessity for replanting and new planting. The present average yield per acre, I understand, is a little over 600 pounds. Your Institute has developed clones which would ultimately yield over 2,000 pounds. To my lay mind it seems a colossal increase and a colossal endeavour. If, as is stated, a large portion of our tea is over 60 years of age, then there is urgent need for replanting. Your Research Officers have shown at these sessions the superiority of the Institute's existing clonal selections over the unselected seedling material. The selected clonal material also offers wide possibilities for the improvement of manufacturing quality. Ceylon tea, as you know, has a reputation for quality, and it is our duty to maintain that reputation. The tea industry, like all other industries, has competitors, and it is in the two spheres of increased yield and high quality that we have surpassed them in the past and need to compete with them in the future.

The Legislature has, under the Tea Thefts Prevention Act, sought to ensure that only tea of good quality leaves the island. This Act enables us to clean the tea export trade of unscrupulous traders who brought the name of Ceylon tea into disrepute. One of the objects of the Act is stated to be to reduce tea thefts. We intended thereby to improve the quality of tea exported. Certain amendments to the Act are necessary as a result of our observation of its operation during the period of 8 months, and I intend to bring those amendments before the Legislature.

That even the small-holder should make his contribution to the maintenance of our reputation as the world's premier producer is also one of the reasons which has prompted us to give assistance to small-holders. I hope that, with the assistance of the Tea Research Institute, I can say that we have achieved some measure of success in forming the small-holders into co-operative societies, so that by getting a better price for his green leaf the small-holder will be able not only to improve his standard of living but also improve the quality of tea, thereby making a substantial contribution to the economy of this country. We have already formed 16 such

societies, covering an extent of about 10,000 acres, and we expect to assist them this year to the extent of nearly two million rupees. I am sure the Tea Research Board, which has taken such a keen interest in seeing that the monies given to them are utilised to the maximum benefit, will give its unstinted support in the future.

I have also issued instructions for the production of a film on the cultivation of tea. This is primarily intended to educate the small-holder, and I am sure that it will also be of considerable assistance to larger producers. The script is now ready and the Government Film Unit expects to commence production in the middle of this year.

Against this background of success, we have had to face the sad news that the Director of the Institute, Mr. J. Lamb, is leaving us after 20 years of intensive research aimed at the development of our major industry. He identified himself with every aspect of research on tea and I hope that he will be able to assist the new Director in the tremendous task that lies before him.

We have also lost the services of Mr. R. C. Scott, who so ably guided the affairs of the Institute as Chairman and chief supporter for 10 years. I have no doubt that his successor, Mr. Henry Hurst, will continue to preserve the reputation of the Tea Research Institute as the premier research establishment in this country.

Reading through some of your papers I notice that Mr. Lamb had requested the Government not to treat the tea industry either as a whipping boy or a milch cow I can assure you, you will not be treated as a whipping boy by the Government, but I do think it will not be unfavourable to be treated now and then as a milch cow!—You will be well looked after, well fed and fattened—because it is only the cream that we want to get out of you.

I would like to refer to the request made to Government to help in the replanting or new planting of tea in Ceylon. While this is a new proposition that came my way I will straight away state:—prepare your scheme and we will give it the most serious consideration.

It is our endeavour to preserve these three major industries—tea, rubber and coconut, so that the benefits derived from them will continue as long as possible.

In the case of rubber you are aware we have already launched out on a very comprehensive scheme.

The coconut industry already has a replanting scheme and we are now preparing a scheme for the rehabilitation of the existing coconut plantations.

The tea industry, apart from the help given to small-holders, has not had any very extensive support, and I now throw out a challenge:—draw up your scheme, come and discuss it with me, and we will see how far we can get on together.

I would also like to say that we realise the great help the tea industry has given to us—the Government and the peoples of Ceylon, and, if I may say so, to those who have invested money.

I am myself a lover of coffee and not of tea and I trust you will not be offended with me for this.

We know the great contribution you have made, the great help you have given us towards the development of our country and the maintenance of a stable economic system.

I trust you will not also forget the benefits you have derived from this island and its peoples, and I trust the tea industry and the peoples of Ceylon will carry on together towards the common goal—a happier life for all of us.

Chairman.—Thank you very much, Sir, for the talk you have just delivered. Personally I have heard you speak before, and it has always given me pleasure to listen to you, but on this occasion it has given me greater pleasure to hear you promise almost at once to render us the assistance asked for.

SOME SELECTED CLOSING REMARKS

Mr. Kenneth Morford, C.B.E., (Chairman, Planters' Association of Ceylon).—On behalf of the P.A. of Ceylon I am very glad to say a few words to thank you and Mr. Lamb for the excellence of this Conference. As one of those who has followed the Tea Research Institute very closely since its inception I feel more and more that the future of Ceylon is bound up with a continuation of the very progressive scientific work carried out by this Institution.

It is very encouraging to note that you have a full complement of staff now to carry on research on each particular line, and I do look forward to a very marked progress in many lines of investigation before the next conference is held again in two years.

I would like to pay a tribute to Mr. Lamb who has had very critical times in this Institute due to shortage of staff; in spite of which he has not only saved the industry but he has literally put millions into the revenue of Ceylon, which if it had not been done would have resulted in Ceylon going bankrupt. I think Mr. Lamb, in his career as Director of the Tea Research Institute, has seen the tea industry successfully through some of the most critical years in our existence.

Dr. Wight has called attention to the fact that the practical man must first get down to the field and do the job, then he can bring his practical knowledge to the scientist, but to expect the scientist to run our estates is surely forgetting our primary job. Then I hope you will remember Mr. Portsmouth's request that we should keep the Tea Research Institute fully informed of our clonal work and co-operate fully in the future.

Another person to be mentioned is Mr. Robert Scott who, as Chairman of the Tea Research Institute Board, has done so much to safeguard and encourage tea research in Ceylon for very many years. Mr. Scott may well be proud as he looks back on the work of these years.

May I have the privilege of addressing a few words to my younger planting friends; we have been listening for the past two days to a series of lectures on the long term policy of tea estates. I have noticed for some time past a tendency to consider that tea is a short term policy—let us get the profits and that is all. I have over 40 years of planting experience and I should like to see every single young man in this room today anticipating the same period of service and I would say to all young planters 'look on tea as a long term policy', and see that from year to year your tea is kept up to the high level which can be achieved, as indicated by the lectures we have listened to.

Dr. T. Eden.—As one of the technical visitors here today, I would like to thank the Board of the Tea Research Institute, the Director and Staff, for giving me the opportunity of coming to this Conference, and I may say that, as neither Mr. de Jong nor myself will be at the Colombo session, he has asked me to associate himself with what I am going to say.

It has been for me a most pleasant and stimulating experience. I remember the first conference which actually took place at the Department of Agriculture at

Peradeniya, and the interest which has come about since those years is most gratifying, particularly in regard to the expansion of the Institute that has taken place during these years.

It is perhaps only now that one in my position should feel sad, as in a way the old gang has now almost completely dispersed. It is, however, very good that there is new blood coming along and I am certain that you can look forward to many years of successful work by the Institute. You are fortunate that your research in Ceylon is extremely cheap compared to the cost of tea research in East Africa, and if only Ceylon gets what East Africa gets I am sure many of these problems could be tackled with vigour and greater success.

I should like to wish Mr. Lamb every success in his new venture and I should also like to congratulate him and his staff on today's proceedings and to wish them all good things in the future.

Dr. Wight (Tocklai Experimental Station).—I would like to close my small contribution to this Conference by saying how much I appreciate having been here as a guest of the T.R.I. It has been a great honour for me to address you at these two sessions of your Conference.

As a specialist in this field I feel it will not be out of place for me to say that I have been very impressed with the work carried out on St. Coombs with regard to the problems and the selection of V.P. material. You have a Station on which you can place absolute reliance.

On behalf of the Tocklai Station I wish your retiring Director good luck and in doing this I feel sure that his new venture will be most successful.

CLOSING ADDRESS BY CHAIRMAN

This brings us to the end of this eleventh biennial Conference.

One thing that has struck me very forcibly in recent years is that the Institute, from top to bottom, has always been concious of our various difficulties. As a consequence the tea industry has advanced by leaps and bounds and has been largely responsible for keeping the good ship 'Ceylon' afloat.

I have been told that the tea industry is so well organised that it has little news value unless we hold a conference or until something goes wrong. Apart from the fact that these conferences are primarily a domestic concern, when we meet together to examine our collective conscience and to disseminate information, they are also educative in that they do a lot to make the general public aware of the fact that the tea industry means all to Ceylon.

Whenever we have had any difficulties of any sort we have appealed to the Tea Research Institute, who have always given us their assistance. Our conferences in the past have accordingly been mainly concerned with dealing out information on how to do things. Various problems have been suitably tackled and the very serious situation arising from the blister blight threat has been completely controlled by our scientists. This Conference has been rather unique in the sense that it has been based on something very much broader, namely, the future of the tea industry. This is of course an extremely important subject and all the papers we have heard have dovetailed into that one theme.

I am very glad to note how very interested the young planters of today are in the industry. The first conference of the Institute I attended was in a half loft of the St. Coombs factory; things have changed so much now. This has been a record conference in the sense that there has been a record attendance of nearly 900. There has, I understand, been a misunderstanding in that some of you were asked to come to Colombo instead of Nuwara Eliya. The reason was that we could not find accommodation for all who wanted to attend at Nuwara Eliya. I am sorry about that but there was, I am afraid, no other alternative.

It is very pleasing to see that there have been so many people interested in the work of the Institute and that such large numbers have attended this Conference. I would thank you for the astonishing success that we have had and for the attention you have given to the papers and discussions.

Before going any further I would like to bring Mr. Lamb before you. He has been with us over 20 years and, this being his last conference, I have first of all to thank him on behalf of the Institute and all of you present here today for all that he has done for the industry and for us. I would ask you to give him what I would call a very good farewell. Thank you Mr. Lamb.

I am very pleased that H.E. the Governor General was able to open our Conference in Nuwara Eliya and today the presence of the Honourable Minister for Agriculture and Food has given us very great encouragement. I do hope that all this will bear fruit.

Dr. Wight has come all the way from Assam to assist in our discussions and we are most grateful to him. We had also Mr. de Jong, of the United Planters' Association of Southern India, with us at Nuwara Eliya.

I thank the Tea Propaganda Board for their generous distribution of tea, the managers of the Regal Cinema, Nuwara Eliya, and of the Savoy Cinema, Colombo, for their co-operation in making such excellent facilities available to us, and finally, Messrs. Harrison Lister Engineering Co., Ltd., for the loan of the fluorescent lighting used in Nuwara Eliya.

The proceedings of this eleventh biennial Conference are now closed.

(END OF CONFERENCE PROCEEDINGS)

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, AT 10 A.M. ON FRIDAY, 10TH DECEMBER, 1954

Present.—Mr. R. C. Scott, C.B.E. (Chairman), Messrs. K. Morford, C.B.E., J.P., U.M. (Chairman, Planters' Association of Ceylon); D. F. Ewen, C.B.E. (Chairman, Agency Section, Planters' Association of Ceylon); D. C. L. Amarasinghe, C.C.S. (Tea Controller), Dr. A. W. R. Joachim, O.B.E. (Director of Agriculture), Messrs. H. S. Hurst, J. L. D. Pieris, W. H. Gourlay, B. Amarasuriya, C. D. Green, F. Amarasuriya, N. B. Parker, G. K. Newton and J. Lamb, O.B.E. (Director and Secretary.)

Also.—Messrs. E. S. Rose, G. A. D. Kehl and J. V. Harbord (T.R.I.).

A letter regretting his inability to attend was received from Mr. V. G. W. Ratnayake, M.B.E., M.P.

1. Notice convening the meeting was read.

2. **Minutes of Board Meeting held on 1st October, 1954**

The minutes were confirmed subject to the amendments notified to members in correction slips dated November 1st and December 1st, 1954.

3. **Matters arising out of the Minutes**

(a) Transfer of Small Holdings Advisory Service to the Tea Controller.

A letter was read from the Ministry of Agriculture & Food cancelling a meeting arranged between representatives of the Board and the Minister to discuss this matter. It was mentioned that the Director, in a review, which he had written and which was to be considered later, had adequately covered the future organisation of the Small Holdings Service, and it was agreed that the pertinent section should be sent to the Minister to form the basis of discussion.

4. **Membership of the Board**

It was reported that:—

(*a*) Mr. G. K. Newton had returned from leave and assumed his seat, relieving Mr. R. M. Macintyre with effect from November 15th, 1954.

(*b*) Mr. F. Amarasuriya had been nominated by the L.C.P.A. to fill the seat rendered vacant by Mr. D. E. Hettiarachchi, with effect from November 10th, 1954.

(*c*) Mr. N. B. Parker had been nominated by the Planters' Association of Ceylon in Mr. A. J. Dickson's place.

The Chairman welcomed Mr. Newton on his return from leave and also the two new members to the Board. He recorded the Board's appreciation of the work done by the two outgoing members, Messrs. Hettiarachchi and Dickson.

5. Membership of the Committees

The Board appointed:—

(*a*) Mr. G. K. Newton to act on the Finance Sub-Committee for Mr. A. D. McLeod, who was expected back from leave early in 1955.

(*b*) Mr. F. Amarasuriya to serve on the Standing Committee and Small Holdings Sub-Committee in place of Mr. D. E. Hettiarachchi.

6. Minutes of the Small Holdings Sub-Committee Meeting held on 1st October, 1954

These were approved.

7. Minutes of the Experimental & Estate Committee Meetings held on 1st October and 20th November, 1954

Both these minutes were approved. With regard to the meeting of November 20th, the Board considered the following specific items:—

3. (1) Roads.—A sum of Rs. 38,000 was approved for a stone crusher (Rs. 22,000), vibratory roller (Rs. 5,000) and 6-ton roller (Rs. 11,000).

4. Constitution of the Committee.—The recommendations of the Special Committee were approved. Representation will therefore be as follows:—

Manufacture and tasting	1	
Morawaka & Southern Province	1	
Sabaragamuwa	1	
Kandy, Matale, Pussellawa	1	
Dimbula	1	
Dickoya & Maskeliya	1	
Uva	2	(1 from Haputale, 1 from Badulla).
Nuwara Eliya	1	
Kalutara & Kelani Valley	1	
	10	

Ex-Officio.—Chairman of the Board, Visiting Agent, Chairman of the Planters' Association of Ceylon or his nominee; The Director, T.R.I. (Chairman); Senior Staff, T.R.I. and Superintendent, St. Coombs.

The Committee will recommend its own nominees to the Board.

6. Capital Account.—It was agreed that St. Coombs was a township and that the advice of Mr. Oliver Weerasinghe, Town Planner, should be sought, and a town survey made.

8. **Minutes of the Low-country Sub-Committee Meeting held on 18th October, 1954**

These were approved.

9. **Minutes of the Standing Committee Meeting held on 4th November, 1954**

Item 6—Board of Survey Report.—The recommendations of the Board of Survey were accepted in full. A sum of Rs. 170,000 for maintenance and Rs. 64,000 for furniture and furnishings was approved.

Proposer—Mr. Hurst.

Seconder—Mr. Amarasinghe.

Item 8—T.R.I. Sports Club.—It was reported that the Club was negotiating with Radella Club to obtain cricket facilities. A sum of Rs. 1,250 was approved for the purchase of cricket gear and hire of ground.

It was agreed that the sum of Rs. 5,600 voted previously for two tennis courts should be used for laying out one court in a more suitable place.

Item 10(c)—Dates of meetings.—The Board agreed to the fixing of dates for Board, Standing Committee and Experimental and Estate Committee meetings as recommended by the Standing Committee.

Item 10(e)—Student training.—The Standing Committee's proposals were approved in principle. Consideration was given to the call by H.E. the Governor-General for closer co-operation between the University and the Tea Industry. It was agreed that it was not within the power of the Board to endow a Chair at the University.

11. **Finance**

(a) The accounts of the Institute to October 31st, 1954, were accepted.

(b) Estimates for 1955.

(i) St. Coombs estimates. These were approved, subject to the following amendments, recommended by the Finance Committee:—

Item 1—*Visiting Agent.*—Fee to be raised from Rs. 500/- to Rs. 1,000/- per visit.

Item 63—*Machinery upkeep.*—Rs. 3,000/- to be added for alterations to shafting and moving roll-breakers.

Item 72—*Waterborne sanitation to lines.*—The estimate for lines 1-15 to be deleted. No expenditure for these lines to be incurred before consultation with the Town Planner. Dr. Macdonald to be asked for advice regarding overhead lavatories and effluent discharges.

Item 73—*Buildings.*—Dr. Macdonald to be consulted about fly-proof traps in the new cattle shed.

Item 74—*New clearings.*—Rs. 3,000/- to be added for a survey and check of the acreage in No. 1 clearing.

A sum of Rs. 9,500/- was also approved for purchase of a car/ambulance for the new dispenser.

Adoption of estimates proposed by Mr. Hurst; seconded by Mr. Morford.

Carried.

(ii) Small Holdings estimates. Approved. Proposer: Mr. Parker. Seconder: Mr. Green.

(iii) Research estimates. Approved with the following recommendations of the Finance Sub-Committee.

Item 74—*Insurance.*—A revaluation should be made of buildings, etc. and insurances revised as necessary.

Adoption proposed by Mr. Amarasinghe, seconded by Mr. Newton. Carried.

12. **Any other Business**

(a) T.R.I. Conference.—It was agreed to hold the second session of the 1955 Conference in the Lionel Wendt Memorial Theatre, Colombo.

(b) Director's review.—It was reported that the Director had written a comprehensive memorandum on organisation of research. Members agreed that the review should be printed for publication as a Monograph, and considered at the next Board Meeting.

(c) Next meeting of the Board was fixed for January 21st, 1955, at 10-00 a.m.

13. **Resignation of Director**

The Chairman reported that he had received a letter from the Director, recording his decision to resign to take up another post in Africa. The Board accepted this letter with regret. The Chairman paid a warm tribute to the work of Mr. Lamb during his twenty years in Ceylon, and then informed the Board of the action being taken to get a new Director. The post had been advertised in 'Nature', 'The London Times' and the local press. Members agreed with the action taken, but decided that the closing date for applications should be extended to January 31st, 1955.

Mr. Newton, seconding the tribute to the Director, made reference to the work of the Institute under his guidance, especially with regard to blister blight and manuring. The tea crop of Ceylon had risen enormously in recent years.

14. **Resignation of Chairman**

Mr. Scott stated that he had been Chairman of the Board for ten years, and that he now wished to hand over the Chair. He referred to the very happy association between himself and the members, both of the Board and the Institute, during this period, and then proposed that Mr. Hurst succeed him. This was unanimously accepted by the Board.

Mr. Morford paid tribute to the great services of Mr. Scott during his long term of office; the reputation of the Institute had never been higher, and the prosperity of the tea industry in Ceylon was a fitting memorial to Mr. Scott's leadership of the Board. Mr. Lamb, on behalf of the Institute, its officers, and himself personally, warmly seconded Mr. Morford's remarks; both gentlemen's tributes were received with acclamation.

Mr. Scott thanked members for their kind words and for their help.

The meeting closed at 3-15 p.m.

Sgd. J. Lamb,
Secretary.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, AT 10 A.M. ON FRIDAY, 21ST JANUARY, 1955.

Present.—Mr. H. S. Hurst (Chairman), Messrs. K. Morford, C.B.E., J.P., U.M. (Chairman, Planters' Association of Ceylon), D. F. Ewen, C.B.E. (Chairman, Agency Section Planters' Association of Ceylon), D. C. L. Amarasinghe, C.C.S. (Tea Controller), V. G. W. Ratnayake M.B.E., M.P., R. C. Scott, C.B.E., B. Amarasuriya, G. K. Newton, W. H. Gourlay, F. Amarasuriya, C. D. Green, N. B. Parker, J. Lamb, O.B.E., J.P. (Director and Secretary).

Also.—Messrs. G. A. D. Kehl and J. V. Harbord, (T.R.I.).

By invitation.—Mr. O. Weerasinghe, M.B.E. (Government Town Planner).

A letter from Mr. J. L. D. Pieris and a telegram from Dr. A. W. R. Joachim, O.B.E. (Director of Agriculture), regretting their inability to attend, were received.

1. Notice convening the meeting was read.

2. **Minutes of the Board Meeting held on 10th December, 1954**

The minutes were confirmed.

3. **Matters arising out of the Minutes**

(a) Transfer of Small Holdings Advisory Service to the Tea Controller.

It was reported that a copy of the Director's Monograph had been sent to the Minister of Agriculture & Food.

(b) T.R.I. Conference.

More than 850 applications for invitations had been received. The combined accommodation at the Regal Cinema, Nuwara Eliya, and the Lionel Wendt Theatre, Colombo was inadequate. The Town Hall, Colombo, had been inspected, but was considered unsuitable. The Managing Proprietor of the Savoy Cinema, Wellawatte, had agreed to lease his cinema for a fee of Rs. 500/-. The other cinemas were not available. Accommodation at the Savoy was 900, and it was agreed to lease this cinema at Rs. 500/-, and to invite the excess number of late applications for the Nuwara Eliya session to attend in Colombo.

Proposer—Mr. Morford.
Seconder—Mr. Gourlay.

4. **Membership of the Board**

It was reported that Mr. W. D. Gunaratna, O.B.E., C.C.S., Controller of Finance, had been appointed to represent the Minister of Finance.

5. **Membership of Committees**

Mr. F. Amarasuiya was nominated to fill Mr. D. E. Hettiarachchi's seat on the Low-Country Sub-Committee.

Proposer—Mr. B. Amarasuriya.
Seconder—D. F. Ewen.

6 **Minutes of the Small Holdings Sub-Committee Meeting held on 9th December, 1954**

These were accepted.

7 **Any Other Business**

(a) Visit to Tocklai.

A proposal that Mr. Portsmouth should return to Tocklai with Mr. Wight, after the Conference, was approved. Mr. Portsmouth might also visit South India on his way. His absence was expected to be from two to three weeks.

(b) Shop at St. Coombs.—

The question of a general shop on St. Coombs was considered. The present caddai keeper had a monopoly which was unsatisfactory, but the terms of his lease prevented his removal for another four years. No decision was reached as to whether the shop should be run by private enterprise or on a co-operative basis, but the Board agreed that the erection of a shop was desirable, and that its siting should be left to the Town Planner. Authority was given to discuss the matter with Mr. La Brooy, lawyer of Hatton, who had a client making enquiries about running a shop.

Sgd. J. Lamb,
Secretary.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle.

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